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Vol. 10. FEBRUARY, 1935. No. 55.

CONTENTS

ISSUED BY THE BRITISH MEDICAL ASSOCIATION.

London: British Medical Association House,

Tavistock Square, W.C.1.

Yearly Subscription (6 numbers), 25/- *Single Number*, 4/6

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ACTINOMYCOSIS IN CHILDHOOD:

A CLINICAL STUDY AND REVIEW

BY

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Actinomycosis or infection with the 'ray fungus' is a relatively rare condition in childhood but is nevertheless of importance in the differential diagnosis of chronic suppuration following appendicitis and of the chronic inflammatory conditions of the jaws, face, and neck. The pulmonary forms of the disease may simulate lung abscess, empyema necessitatis, or tuberculosis, and owing to the difficulty of making the diagnosis from examination of the sputum, the condition is possibly less rare than is generally supposed. In a collected series of six hundred and seventy cases of actinomycosis of all types occurring in the United States, Sanford and Voelker[1] include thirty-nine patients under the age of fifteen years. The following study is based on five cases of actinomycosis in children, three personally observed and two (cases 1 and 2) added from the records of the Hospital for Sick Children. In three of these the infection was primarily abdominal, and in two pulmonary. (Another case, that of a submaxillary abscess, occurring recently in the practice of the Hospital for Sick Children, is not included here but is being reported elsewhere by Mr. Charles Keogh). The autopsy on case 5 was the first to be performed on a patient with actinomycosis in a series of 11,500 autopsies carried out at this hospital.

Aetiology.

Although the term actinomycosis has been applied to infection with any member of the genus Actinomyces, it has been strongly recommended by Colebrook[2] and other workers that this description should be reserved for diseases caused by the Actinomyces bovis, and that infection with other strains should be distinguished by a different nomenclature. The A. bovis is actually the commonest member of the group to cause lesions in man, and is almost certainly identical with that described in cattle as the cause of 'lumpy jaw' and 'woody tongue.' Without entering into the vexed question of the classification of the actinomyces (which is made doubly difficult by the variety of names applied to the same groups by different

authors and by a considerable tendency of the organisms to vary in their morphological characters), it may be said that the great majority of the actinomyces are non-pathogenic inhabitants of the soil, whilst a small minority are responsible for specific infections of plants (potato and beet scab) and of animals. The A. bovis is, typically, an organism consisting of non-septate branching filaments, Gram-positive (but often retaining this stain somewhat irregularly), and is not acid-fast. It grows anaerobically at an optimum temperature of 37° C., but primary culture is often difficult and in many of the cases of human infection was unsuccessful. Actinomycotic pus is characterized by the presence of white or sulphur granules, best seen after shaking the pus with saline. These show a central mass of mycelium surrounded by the radial arrangement of filaments which has caused the name ' ray fungus ' to be given to the organism. The terminal portions of the filaments may be clubbed, giving a characteristic picture on which much emphasis has been laid, but in lesions in man especially, the clubs are not always seen.

For practical purposes, the clinical diagnosis is justified by the finding of an organism having the above morphological characters, and producing pus containing the typical white or yellow granules. Colebrook[2] considers a diagnosis based on these criteria as comparable to that of pulmonary tuberculosis based on the finding of acid-fast bacilli in the sputum. The cases here reported are therefore described as examples of actinomycosis, without further qualification, although primary culture of the organism was unsuccessful.

Source of infection.—Although the organisms causing human and bovine infections are generally regarded as being identical, direct infection of man from cattle is exceptional. Colonel Hamerton[3], pathologist to the Zoological Society of London, states that whilst actinomycosis of bovine type and the closely similar ' kangaroo disease ' are of common occurrence amongst the bovines and marsupials in the Zoological Gardens, no case of human infection amongst the attendants has ever been recorded there. Many of the patients are town-dwellers, and a history of contact with infected cattle is exceptional. Transmission of the disease from man to man must also be rare, although the occurrence of the condition in three members of one family (Knox[4]) and in several inmates of an institution[5] suggests its possibility. Two different theories of aetiology have been suggested, and have been discussed by Wright[6], Mattson[7], Colebrook[2], Lord[8], and others.

Brostroem[9] in 1890 drew attention to the frequent presence of fragments of vegetable matter in actinomycotic lesions in and around the mouth, and he isolated an aerobic branching filamentous organism from actinomycosis of the jaw in cattle, which he regarded as the cause of the disease. Subsequent investigations by other workers make it appear doubtful whether this organism was actually the one responsible. Since the widespread occurrence of such aerobic actinomyces in the soil and grass is well known, it was urged, and widely held, that infection of the mouth or tonsils took place by chewing

or inhaling fragments of infected straw or other vegetable matter. Wolff and Israel[10], however, isolated from two cases of human infection an anaerobic organism which grew best at body-temperature and not at all in the cold. Their findings were subsequently confirmed by Wright[6] and others, and this organism has now been generally accepted as the one responsible for true actinomycosis. Owing to its cultural characters, it appeared improbable that this infecting agent could, except in rare instances, be introduced on vegetable matter, and it was suggested by Wright[6] that it might actually exist as a harmless inhabitant of the mouth or gastrointestinal tract, becoming pathogenic only when it gained entrance through some local lesion. Strong support has been given to this theory by Lord[8] who has isolated typical A. bovis from the mouths of normal, human subjects, and by Naeslund[11] who has produced actinomycotic lesions in animals inoculated with the content of carious human teeth.

Although the theory of infection being conveyed on grass and grain still finds place in many text-books, the view is now generally held that fragments of vegetable matter impacted in the gums or tonsils serve only to cause lesions of the mucosa through which the organism, already present in the mouth, can gain entrance. Similarly, inhalation of a foreign body or inflammation of the appendix may cause local damage allowing pulmonary or abdominal infection to occur. A history of local trauma is not uncommon, and this appears particularly liable to influence the site of superficial lesions after the abdomen or lungs have been invaded.

Age and sex incidence.—Actinomycosis occurs at all ages, the youngest case quoted in most series being that described by Stokes[12] who isolated A. asteroides (not A. bovis) from a lung abscess in an infant dying at the age of twenty-eight days. It is principally a disease of early adult life and is rarer in early childhood than in adolescence. Brofeldt[13], in a study of the disease in Finland, found in a series of 313 cases of which the ages were known, only eight examples in the first ten years of life as compared with fifty three and eighty nine in the second and third decennia respectively. It appears to affect boys more commonly than girls, though the difference in sex incidence is not as great in childhood as in adult life. Thus, the series reported by Sandford and Voelker[1] contained twenty seven boys and eleven girls under the age of fifteen (the sex of one child being unspecified), whereas eighty per cent. of the total series were males. This is probably due to the greater liability of males to trauma of all kinds, a factor which is less operative in childhood than in adult life.

Clinical features.

The disease is characterized by its chronicity, the profuse production of granulation and connective tissue, and the almost invariable tendency of the lesions to break down and suppurate. It advances with little regard to anatomical barriers and is liable to attack every tissue. The lymphatic system, however, usually enjoys a peculiar immunity (a point which is often helpful in differential diagnosis), and though ribs or vertebrae may be eroded,

or show periostitis (as in case 2), it is rare to find the bones extensively involved. Occasionally ulceration of a blood vessel occurs, and the disease becomes disseminated by the blood stream[14, 15]. In one instance, Freed and Light[16] claim to have obtained positive blood cultures.

The prognosis in the abdominal and pulmonary forms of actinomycosis is bad at all ages, but particularly so in childhood. Superficial lesions offer a reasonably good prospect of complete recovery if diagnosed early and adequately treated.

Oral and cervico-facial types.—Owing partly to the frequency of dental caries and to the liability of the gums to trauma, the mouth, and hence the cheek and neck, form the commonest sites of actinomycotic lesions. Thus of Sanford's and Voelker's[1] thirty-nine cases, thirteen had the jaw affected and eight the neck, cheek or scalp, and Figi and Cutts[17] who reported fourteen cases from the Mayo Clinic of actinomycosis in children between the ages of two and fifteen years, found the lesion in ten instances in the cervicofacial area. This site of election is the more understandable when it is remembered that the organism has been demonstrated in the mouths and tonsils of normal individuals. A common sequence of events is that a hard swelling forms around the root of a carious tooth, or on the alveolar margin following dental extraction. This becomes a more or less chronic lesion, and either finally softens and discharges serous fluid or pus by several sinuses, or a reddish-purple indurated swelling appears on the neck or face externally. In some instances there is no demonstrable actinomycotic lesion at what is presumably the site of infection within the mouth and the external swelling is the first indication of the disease. The swelling may be extremely hard and comparable to the ' woody tongue ' of cattle. It is firmly adherent to the deeper tissues, and may resemble an osteosarcoma. Though pain is usually complained of, it is seldom very severe, and the lesion may be hardly tender. The general health at this stage is little affected. After a variable time, often many weeks, softening of the facial lesion occurs, and pus containing the characteristic granules is discharged. If vigorous treatment is instituted whilst the lesion is still localized, the prospect of cure is good, though healing is often slow and there is a tendency for the local lesion to recur. When, however, the disease has spread within the skull or thoracic region, the prognosis is practically hopeless. Of the ten cases of Figi and Cutts, eight were alive and well after periods of from one to seven and a half years, one had died from infantile paralysis, and in one instance death had followed secondary pulmonary involvement.

Abdominal type.—Primary infection within the abdomen occurs in the majority of instances in the region of the caecum and accounts for twenty to thirty per cent. of all cases. In four out of the fourteen cases of Figi and Cutts the infection was of this type, and Edwards[18], in a review of actinomycosis in childhood, records two out of six original cases with involvement of the caecum or appendix. This site appears to be liable to attack when

it becomes a locus minoris resistentiae. Occasionally the appendix is found heavily infected with A. bovis, but more frequently the disease follows an attack of appendicitis, when the appendix has undergone inflammatory changes from the action of other organisms. This is well illustrated by case 1 of the present series. The appendix was examined histologically after it had been removed, and again after the diagnosis of actinomycosis had been made, but showed chronic inflammatory changes only and no evidence of actinomycotic infection. In other cases it is probable that stasis and abrasion of the caecal mucosa have aided the entrance of the organism.

The symptoms of actinomycotic infection may appear almost at once after the original attack of appendicitis or may be long delayed and insidious in onset. In one instance (case 3), after two days' history of abdominal pain, a gangrenous and perforated appendix was removed and turbid fluid found in the peritoneal cavity. The temperature remained raised and pus continued to discharge from the abdominal wound and subsequently from the rectum and vagina. Extension to the thorax took place, probably within eight days of operation, and death occurred six weeks after the first symptoms. The history in cases 1 and 2 was longer. The patients came under observation nine and six months respectively after the original attack of appendicitis. In the first instance, in which the appendix had not been removed at the time of the original attack, the organ showed chronic inflammatory changes only. After appendicectomy had been performed, the temperature continued to swing and laparatomy two weeks later showed a glistening appearance of the abdominal tissues ' as if a snail had crawled over them ' (Waugh[19]). This was followed during the subsequent five weeks by the appearance of a subphrenic abcess and extension to the thoracic wall. Death occurred about four months after the appendicectomy. Case 2 came under observation on account of a superficial swelling over the lower ribs which proved to connect with a large chronic abscess tracking extensively into the thoracic and abdominal walls, and probably connected also with the abdominal cavity. The patient died ten weeks after the appearance of the superficial swelling, and nearly nine months after the removal of a gangrenous appendix.

Cope[20] also described a more chronic type of peri-caecal actinomycosis, in which pain is practically absent in the earlier stages; the patient first came under observation on account of loss of weight or the presence of a hard indurated mass in the right iliac fossa. (This clinical picture appears to be rare in childhood.) Once softening of the mass and suppuration have occurred the later course and prognosis is essentially the same as in the more acute cases—swinging temperature, rapid emaciation, drenching sweats, and sooner or later extension throughout the abdomen or thorax, and death.

Whilst the primary site of invasion within the abdomen is almost always the caecum or appendix, the disease occasionally appears to arise elsewhere (see below); secondary involvement of other organs is common. The

organism may reach the liver by the portal route and give rise to multiple abscesses throughout the hepatic tissue; the appearance of the liver in these circumstances has been compared to that of sponges soaked in pus. Large collections of actinomycotic pus are frequently found in the pelvis, right iliac fossa, or below the diaphragm, and superficial abscesses may form over the lower ribs or abdominal walls. The tendency of the disease to spread to the thoracic wall and pleura is seen in cases 2 and 3 respectively. Once the condition has become established, it almost invariably progresses to a fatal termination in spite of treatment.

Thoracic type.—Whilst pleuro-pulmonary infection frequently occurs by extension of the disease from below the diaphragm, or from the pharynx or oesophagus, infection of the lung is the primary condition in from ten to twenty per cent. of all cases. Here again the disease seems particularly liable to invade the thorax when the latter has been damaged by some other agent. A preceding history of direct trauma to the chest (Huber and Berkowitz[21]) or inhalation of a foreign body has been several times recorded. Case 5 illustrates the latter factor particularly well. The patient inhaled a piece of cocoanut which he was chewing, and had a violent fit of coughing, which was followed by an attack of wheezing simulating asthma. Seven days later the temperature rose to 104° F., and remained raised almost continuously until death occurred. In some cases, pneumonia is possibly a predisposing cause, though it is often difficult to distinguish the ' pneumonia ' from the onset of the disease. Landis and Norris[22] quote a case of a boy of ten who had had pneumonia and empyema at the age of three, and had been in ill health since that time; at autopsy both lungs showed extensive actinomycosis. Although full clinical details are not given, it appears highly probable from the length of history that the disease had recently affected a previously damaged lung.

The condition may occur at any age. Apart from Stokes' patient, an infant of twenty eight days referred to above, pulmonary actinomycosis has been described in infants of twelve weeks (Husick[23]), two years (Does, Gorter and Korthof[24]), twenty six months (Skwortzoff[25]), and two and a half years (Halpern and Levinson[26]). After the age of five years, the condition becomes less rare, and the German and American literature contain a number of cases of pulmonary actinomycosis in children. In France, Nobécourt and Kaplan[27] have reviewed the literature and described one personal observation, whilst recently cases have been reported from Italy by Bollettino[28], from Holland by Does and others[24], and from Poland by Piankowna[29]. In this country, the first case of pulmonary actinomycosis appearing in the literature was that of a boy of nine, reported by Powell, Godlee and Taylor[30] in 1889. Since that time a few isolated cases have been recorded.

Two types of the disease have been recognized, a bronchopulmonary and a pleuropulmonary, but the distinction does not appear to be one of much

practical importance. In either case the onset may be insidious, with loss of weight over a period of months before definite pulmonary symptoms become established, or, as is more usually the case, the onset is more abrupt and the course more rapid. A 'pneumonia' (case 4) is followed by delayed resolution and persistent cough. The child appears disproportionately ill, and the dulness in the chest so marked that an empyema is suspected. There is, however, relatively little displacement of the heart or trachea, and no pus, or a very small quantity only, is obtained on needling the pleural cavity. After a variable time, a superficial swelling containing thick pus is likely to appear

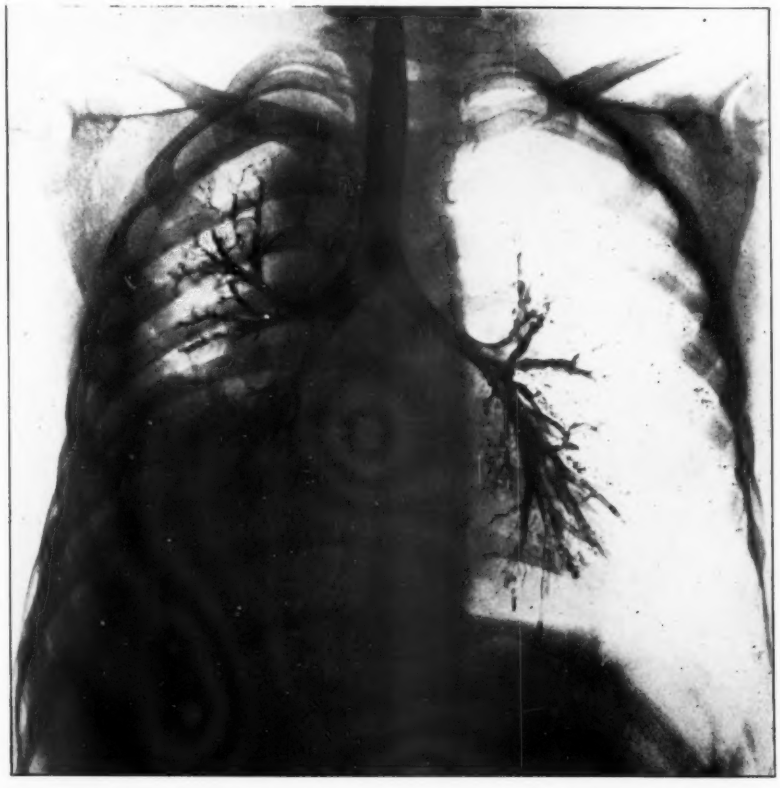

FIG. 1. Case 4.—Lipiodol injection, showing considerable deformity and obstruction of bronchi in right middle and lower lobes.

over the lower ribs on the affected side. Actinomycosis should be suspected if this occurs in the absence of tuberculosis or of dulness to percussion to the level of the clavicle, since an empyema is unlikely to present on the chest wall until the whole of the pleural cavity on that side is filled. In case 4, the right upper lobe remained resonant, and the heart was only slightly displaced to the left, after the abscess had pointed on the chest wall. Rib resection showed that there was no collection of pus in the pleural cavity, and the pleura appeared healthy. This tendency of the organism to spread through tissues showing little naked-eye change, and to form an abscess at some little distance from the original site of infection is not infrequently seen.

The right or left lower lobe is usually first involved and though the destruction of lung tissue may be very great, it is striking that the disease (as in case 5) may remain limited to one lung. From dense consolidation, giving almost stony dulness on percussion, and greatly diminished or absent breath sounds over the affected area, the condition progresses to softening, suppuration and the formation of multiple abscesses. Clubbing of the fingers occurs early, but is not necessarily of extreme degree. Secondary infection of the affected lung tissue usually takes place as soon as the lesion begins to break down and gives the breath and sputum the peculiarly foul odour that is so often noted.

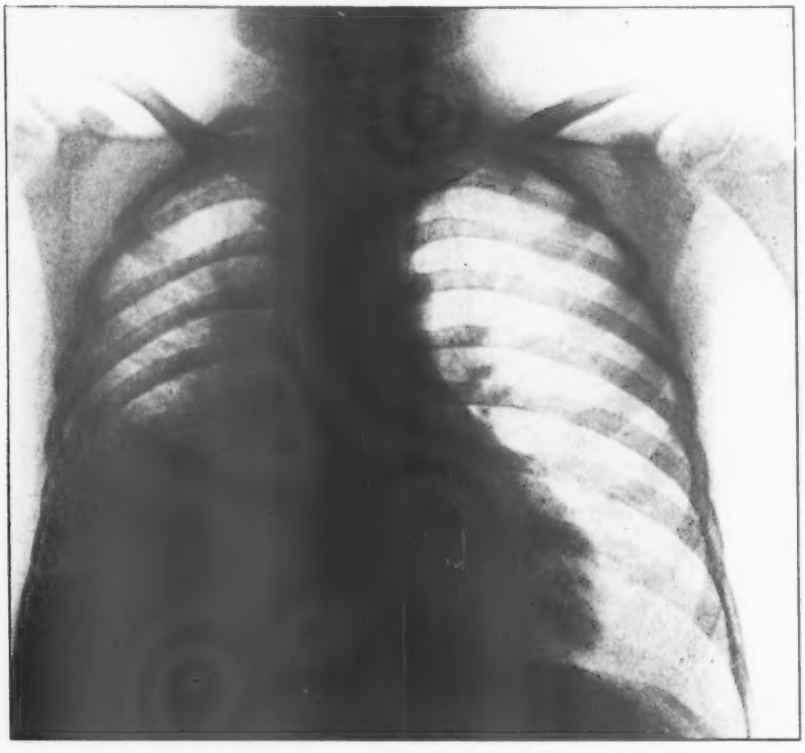

FIG. 2. Case 4.—28.12.32. Heart slightly displaced to left; dense opacity at right base, with marked thickening of pleura over whole of right lung.

The radiological appearances are similar in most of the published cases, a dense homogeneous opacity of the affected lower lobe, with little displacement of the heart. The process may extend to the mediastinum and cause an enlarged mediastinal shadow, but glandular enlargement is seldom demonstrable until secondary infection has occurred. The picture obtained with lipiodol injection is of interest. Fig. 1 shows the appearance seen in the earlier stages of the disease; there is blocking and deformity of the descending bronchi, and the oil fails to enter the area of the left lower lobe principally involved. Corresponding pictures were obtained on several

occasions in case 5, though here the left lower bronchus was blocked half an inch from the bifurcation. After extensive abscess formation had occurred and the boy had been coughing up large amounts of foetid sputum for some weeks, the oil entered the abscess cavities and spread throughout the greater part of the affected lung (fig. 5).

In the relatively few cases in which the diagnosis of pulmonary actinomycosis has been made in children during life, it has usually rested on the examination of pus obtained from the chest wall. It generally appears difficult to isolate the organism from the sputum, since little or no sputum is raised in the early stages before suppuration has occurred, and subsequently

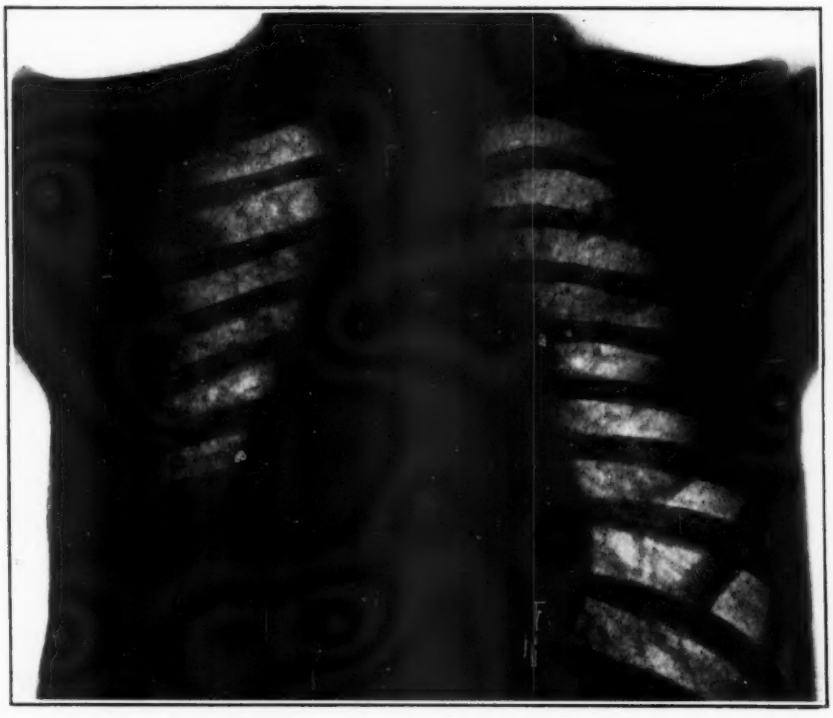

FIG. 3. Case 4.—16.10.34. Right lung field considerably clear, with some residual opacity at right base.

the abundance of secondary infection obscures its presence. It is usually suspected by a process of exclusion. Tuberculosis is excluded in younger children by a negative Mantoux test and examination of the stomach washings, and in older children by direct examination of the sputum. As mentioned above, superficial abscess formation in the absence of other evidence of empyema necessitatis provides the best clue to the disease.

As in the case of abdominal infection, pulmonary actinomycosis in childhood has an extremely high mortality. Although occasional instances of recovery have been reported in adults (Preston[31]), I have not found any

record of one in a child. Cope[20] and Nobécourt and Kaplan[27] described patients who were still alive at the time their papers were published. By courtesy of these authors I learn that in both instances the children died shortly afterwards. Case 4 of the present series is therefore of particular interest, since the boy is not only still alive two and a half years after the onset of the disease (two years after the diagnosis was made from pus obtained from the chest wall), but his general health has steadily improved. Although he cannot yet be described as having completely recovered, the improvement in the physical signs and radiological picture is very marked. The lesion in the right lower lobe appears to have resolved slowly without having undergone extensive abscess formation, and the present state suggests a relatively small amount of pulmonary fibrosis and pleural thickening only (fig. 3).

Cutaneous type.—Cutaneous infection occurring as a primary condition is of extreme rarity, its incidence being estimated by Brofeldt[13] as 1·6 per cent. of all cases. In many of the recorded instances there has been a history of local injury, such different agents as the horn of an ox, the claw of a cat (Vignolo-Lutati[32]), the hoof of a horse, and the tooth of a man (Cope[20]) having been at times incriminated. In other cases, the occurrence of lesions on the hands of those packing or handling straw, or on the feet of those walking barefoot on stubble, has suggested a primary infection from those sources. Carr, Johnson, and Power[33] recorded the cases of two children in which extensive cutaneous lesions were present over the sternum and abdominal wall respectively, and which the authors regarded as primary cutaneous infections. In the former case, however, the history strongly suggests that the skin lesion was actually secondary to infection within the thorax.

Secondary infection of the skin from a more deeply seated lesion is much more frequent, and probably accounts for about ninety five per cent. (Fraser[34]) of the cutaneous cases. As mentioned above, the disease tends to extend to the surface from an abdominal or thoracic site, and involvement of the face frequently follows infection within the mouth.

The cutaneous lesion is first noticed as a firm swelling or nodule in the deeper layers of the skin, attached to the underlying tissues. If there has been an abrasion of the skin, it will fail to heal completely and the edges of the wound will become indurated. The skin at the site of the lesion is often reddish-purple or even blue in colour, and may be surrounded by a number of purple blotches or small flecks (Fischer[35]). The swelling increases in size, and may remain hard as wood until it involves a considerable area, or multiple nodules appear surrounding it. It finally softens, and either discharges the characteristic pus by a number of small sinuses or causes extensive ulceration. The process is essentially a chronic one, and it may happen that a second or a third lesion will arise at the margin or in the scar tissue of a primary lesion that has healed.

An important point in diagnosis is the absence of involvement of the lymphatic glands, which are seldom affected unless infection with other organisms has taken place. The purplish-red colour of the skin, and the chronicity of the condition are also suggestive, but the diagnosis can seldom be made before the organism has been found in the pus.

Other types.—Occasional examples of primary actinomycotic infection of almost every organ have been described but most of these are so rare as to be little more than medical curiosities. Infection of the stomach, which is not very uncommon in animals, does not appear to be of the same importance in man. Stravinsky[36], who has recently reviewed the literature, found only eight examples of primary gastric infection, the youngest case being a male of nineteen. It appears that the presence of a chronic gastric ulcer may predispose to the condition. Secondary infection of the stomach from swallowed sputum might be expected to occur in children with pulmonary actinomycosis, and case 5 at post mortem showed two lesions in the fundus of the stomach which were at first taken to be of this type. Microscopical examination showed only the presence of secondary organisms in the sections. The female genital organs may also be the site of actinomycosis, though generally by the time the diagnosis has been made the disease has spread to such an extent that the primary infection is in doubt. Amongst sixty-six examples collected from the literature, Daniel and Mavrodin[37] include only one child. The patient, a girl of fifteen who had never menstruated, had been ill for a year with pain in the left loin. At post mortem the uterus was found to be of infantile type, and both ovaries almost entirely destroyed by actinomycosis. The renal tract is occasionally affected (Cecil and Hill[38]), and examples of cerebral (D'Ewart and Dawson[39]), aural, lachrymal, and pericardial actinomycosis are also recorded. The pyaemic form of the disease, in which any organ may be secondarily involved, has already been referred to.

Treatment.

Whilst treatment is unsuccessful in the great majority of abdominal and pulmonary cases in childhood, the relatively good prognosis in patients presenting superficial lesions only and the occasional recoveries reported in adults suffering from more extensive disease, encourage energetic treatment from the time the diagnosis is first made. The use of iodides has for long been regarded as specific therapy both for the bovine and human type of infection and, though its value has recently been called in question, the balance of opinion is still in its favour. A small initial dose of potassium iodide should be given in case of intolerance, and the amount rapidly increased. It will be found that most children suffering from actinomycosis will tolerate massive doses over long periods. As an alternative, tincture of iodine, starting with two minims and cautiously increasing, may be given in milk. When the patient is intolerant of oral administration, Lugol's iodine can be used intravenously.

Iodine is also used for local application, the tincture being applied to superficial lesions, and iodoform gauze being employed for packing abscess cavities. Johnson and Kernan[10] have recommended bronchoscopy and the injection of iodised oil (lipiodol) in the treatment of pulmonary actinomycosis, and Raimondi, Pardal, and Mazzei[11] have also practised lipiodol injections. This was done by the cricothyroid route in cases 4 and 5, though it was found in both instances that there was blocking of the bronchi of the affected lobe in the early stages of the disease, and it was not until extensive cavitation (fig. 5) had occurred that the oil spread throughout the lung in case 5.

Copper salts have been extensively used recently in the treatment of the disease, and some good results have been claimed for them. Colebrook[12] and Cope[20] have also recommended the use of vaccines consisting of fragments of the organism, and have obtained some promising results in conjunction with surgical drainage. X-ray therapy has been employed by a number of workers, but in children it does not appear to have given any very striking results. Surgical treatment has a limited application, and in visceral cases the aim should be to provide free drainage of abscesses rather than to attempt extensive removal of tissue. Local and superficial lesions can sometimes be successfully excised.

The use of insulin and glucose (one unit of insulin to three grammes of glucose, given intravenously) has been advocated by Jacobson[13] as an adjunct to other forms of general treatment, and in view of the chronicity of the disease this may prove of value in stimulating appetite and preventing wasting. The same author has employed non-specific protein shock, in the form of typhoid-paratyphoid vaccine with suggestive results.

Case records.

Case 1.—Abdominal type.

T. C., a boy aged eleven years, four months, was admitted to hospital on 20 November, 1923, under Mr. George Waugh with a history of having had an attack of appendicitis nine months previously, and intermittent pain in the right side of the abdomen since then. The child had not been operated on at the time of the original attack. Pain was unrelated to food, and there had been no vomiting but some nausea in the mornings. There had been no cough, and no sweating until three weeks before admission. The bowels were usually constipated, and there had been intermittent pyrexia. Family history and previous history were irrelevant. The child lived in London.

On examination. A pale child, temperature 99° F., pulse 133, respiration 24. The tonsils were enlarged, the tongue clean, the heart and lungs normal. Small discrete glands were present in neck; the abdomen moved well on respiration; there was no palpable tumour but some tenderness and rigidity of right flank. The lower border of liver extended one inch below costal margin. Urine was normal.

BLOOD COUNT. White blood corpuscles, 23,750 per c.mm.

X-RAY. A bismuth meal showed ileo-caecal stasis.

OPERATION BY MR. WAUGH (23.11.23). The abdomen was opened by a right paramedian incision, a small amount of free fluid being found present. Portions of the omentum were adherent to the lower abdominal wall, but not in connection with any evident pathological focus. The appendix was situated retro-caecally and was embedded in peri-appendicular adhesions. The caecum was unusually mobile. The appendix, which showed a marked degree of inflammatory change, was removed after extricating it from its bed of adhesions and the base invaginated. The peritoneum was closed.

Section of the appendix showed signs of chronic inflammation with great thickening of the walls. No streptothrix was seen in sections stained by Gram's method.

COURSE. The patient's condition was good following the operation, but the temperature rose irregularly to 103°, and on 30.11.23 (a week after operation) it was noted that there was dulness at base of the right lung and tenderness on pressure high up in the right flank. The urine contained a few hyaline casts and was sterile.

BLOOD COUNT (4.12.23). White blood corpuscles 22,000 per c.mm. Polymorphs., 70 per cent.; small lymphocytes, 20·5 per cent.; large lymphocytes 9 per cent.; eosinophils, 0·5 per cent.

8.12.23. An area of localized tenderness was found above the right iliac crest, just lateral to the erector spinae muscle. An incision was made over this point under general anaesthesia, and the underlying parts explored. The peritoneum was opened behind the ascending colon but only a slight amount of dry plastic peritonitis was found.

21.12.23. Thirty c.c. of one per cent. chloramine injected intravenously. Blood culture was sterile.

3.1.24. X-ray (screen) showed complete immobility of right diaphragm, which was not raised, but consistent with a subphrenic abscess. The temperature remained raised.

11.1.24. An exploratory laparotomy was performed by Mr. Waugh. The liver was found adherent to the peritoneum in the floor of the incision. There was much perihepatitis, and a large quantity of thick lymph was removed from between the liver and diaphragm. No pus was obtained. The cavity between liver and diaphragm was packed with iodoform gauze, and a tube was placed in the region of the hepatic flexure. Oxygen and camphor were administered during the operation and 20 oz. of five per cent. glucose in saline given intravenously.

Report on material from subphrenic region: 'No organism seen. Cultures sterile.'

14.1.24. The iodoform plug was removed followed by considerable discharge of foul-smelling pus. A drainage tube was inserted. The temperature continued to swing and the general condition deteriorated. On January 20, an icteric tint of conjunctivae was noted and a week later a swelling appeared over the right lower ribs in the posterior axillary line.

30.1.24. The swelling over ribs was incised, and thick white pus obtained. Forceps inserted into lumbar region and below right anterior costal margin and tube inserted.

EXAMINATION OF PUS. The films showed Gram-negative and positive cocci. The cultures were sterile.

The wound continued to discharge thick pus, and in the region of the original incision, the tissues became reddened and oedematous, with secondary abscesses pointing in several places.

Actinomycosis was suspected, and examination of the pus on 21.2.24 showed the presence of granules. In the fresh film, clubs were seen, irregular in shape and size, and in the stained film, filaments of Gram-positive branching streptothrix.

The patient was treated with pot. iod. gr. xx, and copper sulphate gr. $\frac{1}{2}$ t.d.s. for the following month, but as the general condition was steadily getting worse, he was removed from hospital by the parents on March 26, 1924, in a dying condition.

Case 2.—Abdominal type.

J. M., a girl aged eleven years was admitted to hospital under Mr. Higgins on 13.7.31, with threee days' history of a swelling over the right lower ribs posteriorly. She had been hit by a cricket ball at this point several days before the swelling was noticed.

In January, 1931, a gangrenous appendix had been removed, and in April, 1931, she had suffered from an attack of influenza.

ON EXAMINATION. The patient was an ill-looking child; temperature 102° F., pulse 128, respiration 28. A large fluctuant abscess was situated over the right lower ribs posteriorly. The chest was dull to percussion at the right base. The abdomen showed nothing abnormal except an appendicectomy scar and slight rigidity on right side.

15.7.31. The abscess was incised and left open without drainage.

BACTERIOLOGICAL EXAMINATION. The pus evacuated was greenish yellow in colour, slightly blood stained, and contained sulphur yellow granules. A stained film showed pus cells and a fair number of Gram-positive branching filamentous organisms, having the appearance of A. bovis. On staining with Ziehl-Nielsen, no tubercle bacilli were seen. Cultures were sterile in seven days. A second examination of the pus made on the following day again showed the same organisms present. Subsequent examinations of pus on 29.7.31, 7.8.31, and 17.8.31, showed a few colonies of staphylococcus aureus only, but on August 21, 26, 27, and 31, and September 3, 7, 15, and 19, the typical mycelium was again seen. Cultures in each case grew staphylococcus aureus (and in one instance, coliform bacilli) only.

Examination of the faeces was repeatedly negative for actinomycosis; cultures made from the urine were sterile.

BLOOD EXAMINATION. 11.8.31. White blood corpuscles, 23,900 per c.mm.; polymorphs, 70 per cent.; lymphocytes, 24 per cent.; large monocytes, 6 per cent. 12.9.31. Red blood corpuscles, 2,300,000 per c.mm.; white blood corpuscles, 14,400; Hb., 35 per cent.; polymorphs, 88 per cent.; lymphocytes, 12 per cent.

COURSE. Although the abscess drained freely, the patient continued to have a swinging temperature (104°) and the general condition rapidly deteriorated. She was treated with increasing doses of potassium iodide without improvement.

X-RAY. 12.8.31. Showed periostitis of tenth and eleventh ribs.

OPERATION BY MR. HIGGINS. 13.8.31. An incision was made over the abscess and was extended in several directions; portions of the tenth and eleventh ribs were resected, and a large chronic abscess was discovered. It extended upwards deep to the lower ribs and superficial to the parietal pleura, and below extended medially to the region of the posterior abdominal wall. Much purulent debris was evacuated, and the abscess wall curetted. It was thought that the cavity was connected with the abdominal cavity, and related to the appendix removed in January, 1931, with a possibility of extension to the right lung and liver. The cavity was syringed with Dakin's solution and Carrel-Dakin tubes inserted. The abscess cavity remained open and drained thick offensive pus.

15.9.31. The chest showed fine crepitations at both bases, and the abdomen slight general distension; the liver and spleen were not enlarged. The abscess had extended towards the midline posteriorly.

18.9.31. Blood transfusion given (20 oz. of father's blood).

OPERATION BY MR. HIGGINS. 25.9.31. Extension of abscess incised, and the skin and subcutaneous tissues were found riddled with sinuses. The communication with the right posterior abdominal wall was still present.

The patient died on September 28, 1931, ten weeks after admission to hospital.

Post-mortem examination was not allowed.

Case 3.—Abdominal type.

I. N., a girl aged nine years, was admitted to hospital on October 17, 1933, under Mr. Eric Lloyd, with two days' history of abdominal pain, vomiting, and constipation. The pain was referred to the suprapubic region. She had previously been in hospital (6.6.32 to 16.8.32) with chorea and rheumatic carditis.

ON EXAMINATION. She was a pale ill-looking child, temperature 100° F., pulse 160, respiration 40. The tongue was furred and the heart enlarged to the left, with a soft systolic murmur at the apex. The lungs vere clear. The abdomen showed no definite rigidity at the time of admission, but slight tenderness in the mid-line below the umbilicus; the abdominal reflexes were absent in the right and left lower quadrants. Generalized rigidity of abdomen developed a few hours after admission. Rectal examination was negative.

OPERATION BY MR. HINDENACH. A large quantity of free fluid (turbid but not offensive) was found in the peritoneal cavity, particularly in the pelvis and right iliac fossa. The appendix was greatly swollen, the distal end being perforated and gangrenous. The appendix was separated with difficulty from its mesentery, its base clamped, and the organ removed. The base could not be turned in, but the caecum was sewn over it. Drainage tubes were inserted into the pelvis and right iliac fossa. The pus obtained and cultured at the time of operation grew coliform bacilli only.

BLOOD COUNT (after operation). White blood corpuscles, 22,500 per c.mm. Polymorphs, 74 per cent.; lymphocytes, 20 per cent.; monocytes, 6 per cent.

COURSE. A profuse discharge continued to drain from both tubes, and the temperature remained raised, swinging to 102°. On the third day, there was distension of the abdomen and all feeds were vomited, and three days later the child began to cough and become increasingly restless. She was given continous intravenous glucose for three days.

25.10.33. The chest showed dulness at the left base, and râles at both bases. Secondary haemorrhage occurred from the abdominal wound and the following day the discharge became faecal. Subsequently a large swelling was felt per rectum, filling up the pelvis, and pus began to discharge from the rectum and vagina. The signs at the left base persisted, with diminution in vocal fremitus and resonance in this area. On November 15 aegophony was noted at the upper level of dulness, and moist crepitations in the lung above. The left chest was aspirated posteriorly on October 18, but only a small quantity of blood stained fluid was withdrawn. The stained film showed this to be mainly blood; no organisms were seen, and cultures were sterile.

23.11.33. Eight c.c. of foul ' anchovy paste ' pus were aspirated from the left pleural cavity posteriorly, medial to the angle of the scapula.

EXAMINATION OF PUS. No granules were seen. The stained film showed very degenerate material. A few Gram-negative bacilli and a fair number of branching streptothrix ' almost certainly actinomycosis ' were noted.

Intense iodine therapy was commenced, but the child died suddenly on November 26, six weeks after the onset of symptoms.

Post-mortem examination was not allowed.

Case 4.—Pulmonary type.

N. P., a male, aged six years nine months, lived in London and had never been out of town except twice for the day (to Clacton), had had no known contact with cattle, or any farm or dairy worker. His father, a painter, was well; his mother and one older brother were well. His infancy was normal. He had pneumonia at two, pertussis at three years of age, and measles in May, 1932 (at the age of five years and three months) with uneventful recovery.

In August, 1932 (aged five-and-a-half years) he had pain of sudden onset in the right side of the chest, and was in bed for two to three weeks. He did not make a satisfactory recovery, and continued to have a slight cough. He was admitted to Victoria Park Chest Hospital in November, 1932, where he was x-rayed and the chest needled; no fluid was obtained. He was taken out of hospital against advice, and subsequently admitted to the London Hospital under Dr. A. G. Maitland-Jones on December 27, 1932.

On examination (28.12.32). A moderately well-developed, ill-looking boy, with marked pallor and definite clubbing of the fingers. There was a tendency to cyanosis of the lips and some slight cough and dyspnoea on exertion. No sputum was raised. The temperature was 104·5° F., respiration 40, pulse 130. A fluctuant swelling measuring three quarters of an inch by one and a half inches was situated on the right chest wall, at the level of the sixth and seventh ribs, just outside the mid-clavicular line. The skin covering it was dark red, and moderately tender. There were dilated veins over the right chest anteriorly. The chest showed diminished movement on the right side, with slight flattening of the lower ribs. The percussion note was normally resonant over the left chest, slightly impaired over the right apex, and stony dull over the right side of the chest to the level of the third rib above. Air entry was greatly diminished over the right lower lobe, with an area of bronchial breathing at the angle of the right scapula. Very occasional crepitations were heard at the right base. The apex beat was immediately external to the mid-clavicular line in the fourth interspace. The heart sounds were normal. No other signs of disease were found. The Mantoux test was weakly positive (1 in 1,000 dilution).

Course (4.1.33). The right chest was needled in four places, but no pus was obtained from the pleural cavity. The swelling was incised and drained, several cubic centimetres of thick yellowish blood-stained pus being evacuated.

Examination of the pus by Dr. P. N. Panton showed the presence of many pin-head yellow granules, with numerous filaments of Gram-positive streptothrix in the film, which appeared typical of actinomycosis. The organism at first grew anaerobically, but cultures subsequently died out.

Radiological examination (28.12.32) showed the heart slightly displaced to the left and a homogeneous opacity at the right base resembling consolidation, with marked thickening of the pleura over the whole of the right lung (fig. 2). Lipiodol was injected by the cricothyroid route on 11.1.33, and showed considerable deformity and obstruction in the bronchi in the right middle and lower lobes (fig. 1).

Intensive idodide therapy was started as soon as the diagnosis was made, the dosage being increased up to 120 grains a day for several weeks. The boy has had from 40 to 60 grains a day almost continuously during the past two years, except for one three-month period during which it was remitted.

The temperature and respiration rate fell to normal on the third day in hospital, and except for one or two slight rises (to 101°), the boy has been afrebrile since this time. The chest wound continued to drain small quanties of sero-sanguinous discharge and thin pus for six to eight weeks, and then healed. A second small fluctuant swelling appeared on the chest wall, posterior to the old wound, five months later, but settled without incision.

The general health has improved slowly during the past two years, and the boy has gained eight pounds in weight. Apart from slight dyspnoea on exertion he is free from symptoms. The physical signs in the chest remained practically unchanged for nearly

FIG. 4. Case 5.—Left lung almost completely opaque, and heart drawn to left.

twelve months, although the x-ray showed some degree of clearing. Since this time there has been considerable improvement in both x-ray and physical signs. He now (January, 1935, aged seven years and ten months) has impaired percussion note over the right lower lobe only, and moderately good air entry in this area. The movement of the right chest is only slightly diminished, and the clubbing of the fingers is less marked.

Radiological examination (16.10.34) shows very marked clearing of the right lower lobe, with some residual shadowing at the base. (This case was shown at a meeting of the Children's Section of the Royal Society of Medicine[14] in January, 1933.)

Case 5.—Pulmonary type (autopsy).

K. S., a male, aged four and a half years, was an only child of healthy parents, living in an agricultural district in Kent. There was no known contact with actinomycosis, but frequent association with horses and cattle. He was well until July 7, 1934, when he inhaled a small piece of cocoanut pulp whilst running. This was followed by an attack of dyspnoea closely resembling asthma. Seven days later he had a sudden rise of temperature to 104° F., and respiration rate to 58, and he was diagnosed as having lobar pneumonia. The temperature remained raised until the eleventh day when there was a pseudocrisis. Subsequently the temperature continued to swing between 99° and 102°. There was grunting respiration and some asthmatic wheezing in the evenings.

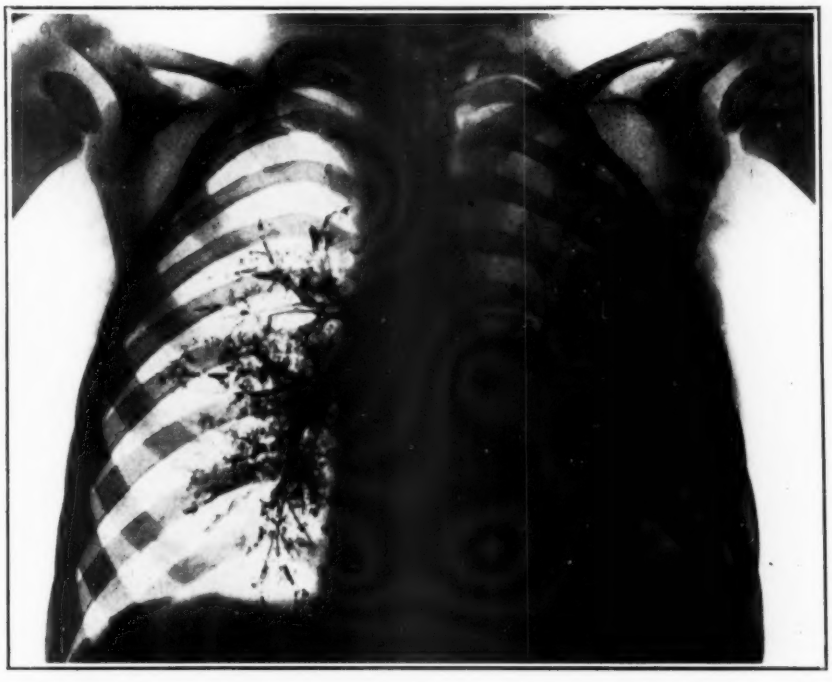

FIG. 5. Case 5.—Lipiodol injection, showing multiple abscess cavities at left base.

Skiagrams taken on July 16 showed relatively little infiltration of left base; there was no sign of fluid. He was referred to hospital August 16, 1934, by Dr. A. F. Cole, of West Malling, to whom I am indebted for the previous history, and admitted under Dr. Cockayne.

ON EXAMINATION. He was a pale, wasted boy with considerable respiratory distress and frequent cough. His temperature was 101° F., respiration 40, and pulse 128. There was early clubbing

of fingers. No displacement of trachea was noted. The apex beat was not palpable. There was dulness half an inch to the right of the sternum. No cardiac murmurs were heard. There was diminished movement of the left side chest and stony dulness at the left base with diminished resonance over the whole of the left lung except at the apex. The breath sounds were diminished over the left lung except at the apex, and they were tubular over the lower part of the left upper lobe. The right lung was normal. The tongue was furred, the tonsils red. There were two carious right upper molars. The ears and abdomen were normal. A skiagram showed almost complete opacity of left chest with very little displacement of heart. An exploratory puncture was made on the night of admission in the eighth left intercostal space in the posterior axillary line, and a few drops of thick pus obtained with the needle one inch from the surface. White blood count: 32,450 per c.mm.

17.9.34. Operation under local anaesthetic. Openings made in eighth and ninth left intercostal spaces. No pus was obtained. The lung felt hard, but the pleura appeared normal. Two catheters were inserted.

18.9.34. Catheters removed. Mantoux tuberculin test was negative in 1 in 1,000 dilution.

The following day the wound began to discharge thick yellowish pus with extremely offensive odour.

PATHOLOGICAL REPORT on the yellow pus. On emulsion with saline, typical sulphur yellow granules were present. A wet film showed granules with rosette arrangements and radiating clubs. Stained by Gram and carbolfuchsin: Gram-positive cocci were seen in clusters and Gram-positive streptothrix of all sizes, occasionally in clusters. Stained with Ziehl-Nielsen, no tubercle bacilli were seen; the streptothrix was not acid fast. The streptothrix failed to grow aerobically or anaerobically.

COURSE. The patient was treated with increasing doses of potassium iodide (up to 60 grains four hourly), and with repeated lipiodol injections intra-tracheally. The general condition rapidly deteriorated, with extreme wasting. Clubbing of fingers became more marked, but not extreme. Temperature rose to 104° F. a week before death, which occurred one month after admission.

POST-MORTEM EXAMINATION. (Examination of brain not permitted.) The body was greatly emaciated: weight 25 lb., length 45 in., an open wound with a necrotic margin was present in left side of chest (eighth and ninth interspaces in posterior axillary line). The mouth was foul and contaminated with sputum, with two carious right upper molars but no induration of alveolar margin. The tonsils were small and sections showed some chronic inflammatory changes. The salivary glands and cervical glands presented no changes.

The whole of the surface of the left lung was purplish-red in colour, the visceral pleura being rough and indurated and its vessels

engorged. The parietal pleura had lost its glistening appearance and from the mid-axillary line backward the parietal and visceral pleurae were firmly adherent. There was no free fluid in the left pleural cavity, but a sinus surrounded by dense adhesions connected a large abscess in the left lower lobe with the external opening in the sixth interspace, and a small amount of thick green pus was adherent to the apex of the left upper lobe posteriorly. Medially, the parietal pleura was adherent to the pericardium.

FIG. 6. Case 5.—Left lung showing thickened pleura, fibrosis, and multiple abscess cavities; right lung unchanged.

The left pleura was found greatly thickened and indurated and the surfaces of the interlobar pleura adherent. The normal lung structure was completely destroyed, the greater part of both lobes presenting a honeycombed appearance due to multiple abscess cavities filled with foetid greenish-grey pus, which showed the presence of yellow granules after shaking with saline. The abscess cavities varied in size from two or three millimetres in diameter to one in the left lower lobe the size of a walnut; the lining of

the cavities was ragged and necrotic. Surrounding the cavities and underlying the pleura were areas of consolidation and dense fibrosis; the vascularity of the whole lung was increased. The main bronchi contained thick pus.

Histological examination of the left lung showed irregular areas of young fibrous and granulation tissue, and necrosis in the vicinity of the abscess cavities. Very many Gram-positive cocci and leashes of Gram-positive streptothrix were present throughout the sections; the latter showed a tendency to rosette formation in several areas, but no clubs were seen.

The right lung and pleural cavity appeared normal naked-eye and microscopically except for some terminal oedema and congestion at the base of the right lower lobe. The bifurcation gland was considerably enlarged and beginning to break down; one tracheo-bronchial gland on the left side was fibrosed, and the remainder slightly enlarged, but sections of these showed no evidence of streptothrix within them.

The heart showed no changes. The pericardium, though adherent to the left lung, was not indurated. The liver was in a condition of early fatty degeneration. The kidneys showed pallor of the cortices and microscopically some hyaline degeneration of the tubules. The pelvis of the right kidney contained a small calculus (the size of a split pea), and both ureters were distended with urine. Two calcified mesenteric glands were present in the right iliac fossa.

The stomach contained a small quantity of swallowed sputum, and there were two small areas of ulceration of the mucosa of the fundus. These had indurated margins, and were surrounded by areas of haemorrhagic staining. Histologically, many Gram-positive cocci but no streptothrix were seen in sections of the ulcers. The caecum and appendix showed post-mortem staining, but no evidence naked eye or histologically of actinomycotic infection. The peritoneum and other organs showed no abnormality.

Summary.

1. Actinomycosis, though rare throughout childhood, occurs even in early infancy. The disease is less uncommon in boys than girls. In most instances, the Actinomyces bovis is thought probably to exist within the mouth or gastro-intestinal tract, and to become pathogenic when it gains entrance to the deeper tissues through an abrasion or area of lowered resistance of the mucosa.

2. The clinical features of the commoner types of actinomycotic infection are described. The mouth provides the most frequent site of invasion, and next to this the caecum and appendix.

3. Five illustrative cases of actinomycosis occurring in children are reported. Three of these were of abdominal type, with extension to the thorax, and two were pulmonary. Of the latter, one is alive and shows improvement clinically and radiologically two-and-a-half years after the onset of the disease. The post-mortem findings in the other case are reported.

It is a pleasure to thank Drs. E. A. Cockayne and A. G. Maitland-Jones, and Messrs. G. Waugh, T. Twistington Higgins, and E. I. Lloyd for permission to report cases admitted under their care, Drs. P. N. Panton, D. Nabarro, and A. Signy for bacteriological investigations, and Drs. B. Shires and L. J. Rae for radiological reports.

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THE INCIDENCE OF THE VARIOUS TYPES OF PNEUMOCOCCI IN INFECTIONS OTHER THAN PNEUMONIA

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The pneumococcus is not infrequently responsible for infections other than pneumonia and in these cases the typing of the causative organism is a matter of some importance. It is now accepted that the typing of strains of the pneumococcus isolated from cases of pneumonia constitutes an important part of the bacteriological examination of material obtained from such cases. This is particularly emphasized by the conclusive demonstration of the value of specific serum therapy in cases of type I pneumonia. While the same practical value has not been attached to the typing of pneumococci obtained from other infections, the results given below provide some interesting data.

It has been observed both in America and in this country that empyema is more frequently caused by the type I pneumococcus than by any other type. Cecil and Plummer[2] stated that empyema was twice as common in type I than in type II pneumonia, while endocarditis was more frequent after type II infection. Whittle[5] found 24 out of 31 cases of empyema to be due to the type I pneumococcus and Smeall[4] 14 out of 21 cases. Glynn and Digby[3] also isolated the type I pneumococcus with the greatest frequency from cases of empyema. Blacklock and Guthrie[1] found that while in children group IV strains predominated in the empyemata following broncho-pneumonia, the incidence of fixed types rose with the age of the child. From these cases the type I pneumococcus was usually obtained.

The following results were obtained from the examination of material obtained from cases, mainly children of school age, in the Manchester district between 1932-1934. Cultures were made on blood agar, from which single colonies were placed into tubes of Hartley broth. These cultures were employed for a macroscopic agglutination test after a preliminary test for

bile solubility. The frequency with which the various types were encountered is shown in the table:—

	Types			Group	Total
	I	II	III	IV	
Empyema	51	4	–	4	59
Meningitis	5	4	1	2	12
Other conditions ...	1	1	1	1	4
	57	9	2	7	75

One point is outstanding and that is the high incidence, 87 per cent., of the type I pneumococcus in cases of empyema. In other infections examined there was no such tendency to predilection of type.

This raises an important question. Pneumococcal empyema is invariably a sequel to pneumonia, and the remarkable frequency with which the type I organism is isolated, is considered to be an indication of the marked invasiveness of this type of pneumococcus. It is now generally accepted that this is also the type of pneumonia which responds well to serum therapy. These facts suggest that as early serum therapy of type I pneumonia becomes more widely applied the incidence of empyema should decrease. The above figures have been obtained from patients who had not received serum and probably serve to emphasize the necessity for the early administration of serum in cases of type I pneumonia.

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PAPULAR URTICARIA (LICHEN URTICATUS)

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Although papular urticaria is, perhaps, the commonest of all the skin disorders of childhood, it receives but scant mention in most of the text-books on dermatology or paediatrics, and relatively few systematic investigations of the disease have been made. This neglect can doubtless be attributed to the benign character of the complaint: it is not a direct menace to life, nor does it constitute a permanent disability. Nevertheless it is an important childish ailment, not only on account of its great frequency, but also because it occasions a good deal of misery in those whom it afflicts, and much anxiety in those responsible for their care.

In spite of the large amount of material available for study, no agreement has been reached either as to the nature or aetiology of the complaint, nor has a satisfactory treatment been discovered. This inquiry was undertaken to see what light could be thrown on these problems, especially that of aetiology, by the analysis of the records of 299 patients under twelve years of age who attended the skin department of the Children's Hospital, Birmingham, between January, 1930, and December, 1933; and by a few simple experiments in a smaller number of selected cases.

It is not proposed to review in detail the whole of the past literature on the subject, but a few salient points require mention. Ever since the appearance of Bateman's first description, and probably before that, papular urticaria has been recognized as essentially a disease of early childhood, and equally well known is the aggravation of the symptoms by heat, hence the popular term 'heat spots.' In addition to these two factors, its cause has been ascribed to a wide variety of agents and conditions. These many different views are not necessarily mutually exclusive. Papular urticaria might be a cutaneous reaction which can be evoked by a number of different stimuli, and some of the alleged causes, while not exciting agents, might predispose to, or aggravate the disease. For a long time, digestive disorders were, by most observers, placed first in the list of causes, but in more recent years the condition has been accepted almost universally as a manifestation of allergy. Much difference of opinion still remains, however, concerning the nature of the allergen. Food is usually regarded as the offender, proteins being most often incriminated, but carbohydrates have also been blamed, while Bray

assigns chief place to fats, especially those derived from pork. Strikingly at variance with the commonly accepted views are the experiments of Tilbury Fox and Hallam, who showed that merely admitting patients to hospital brought about rapid cure, relapse occurring only on their return home. As a result of dietetic and other experiments with patients in hospital, Hallam came to the conclusion that the cause of papular urticaria is not food, but some environmental factor.

The experimental approach is obviously the best method of determining the exciting cause of the disease, but Hallam's researches left out of consideration certain other important influences, notably the effect of heat. The present series of experiments was therefore undertaken with a view to rectifying such omissions, and it may be stated here that the results largely confirm Hallam's views. The experimental method, however, throws but little light on predisposing factors, so that a more extensive review of the subject was deemed advisable.

The nature of papular urticaria.

In its clinical features, papular urticaria bears resemblances to two conditions, the ordinary urticaria of adults, and Hebra's prurigo. Lewis has shown that the urticarial reaction in adults is a triple response to a histamine-like substance, 'H-substance,' acting locally on the vessels of the skin. Papular urticaria, however, is a quadruple response: will H-substance, acting on a child's skin, produce the additional element, the papule?

The effect of histamine.—A 1 in 1,000 solution of histamine phosphate was pricked into the skin of a patient who had been subject to papular urticaria for two years, and who was actually suffering from an attack. Whealing occurred exactly as in normal controls. The wheals had completely subsided at the end of two hours, leaving no palpable or visible trace at all.

The effect of 'H-substance.'—Small pieces of nettle leaf were applied to the skin of the same patient, and again whealing occurred in the usual manner, without any suggestion of papule formation. H-substance may be liberated, and an urticarial response evoked, by insect bites. In two cases I have had the opportunity of observing recent flea bites in sufferers from papular urticaria. In each instance the bites produced prominent wheals, which, subsiding after about two hours, left behind minute red puncta, but no trace of papules. Hallam has shown that the bite of a bug results, in such children, in an urticarial reaction, but it does not leave the characteristic papule.

It is clear, therefore, that external stimuli which evoke an ordinary urticarial reaction in adults, evoke precisely the same response in children, even though the children be subject to papular urticaria. It is more difficult to test stimuli acting from within, but there is one such agent, the effects of which are seen relatively often. The injection of animal

serum is frequently followed by urticaria, both in children and adults, and the urticaria which it causes in children is of the ordinary form, never papular urticaria. It is true that, except for this serum rash, typical urticaria is not common in children, but it does occur, and is probably not so rare as is usually supposed: I have seen some dozen or more examples of it during the past four years.

Lastly, quite apart from external agents or serum, urticaria and papular urticaria may occur independently in the same patient. This is not merely an example of a single disease undergoing a change of form, for the two reactions are provoked by different exciting stimuli. This is clearly illustrated by the following case :—

> D.S., a female, was first brought to hospital at the age of twelve months, suffering from generalized eczema of eight months duration. This cleared up under treatment, although slight outbreaks in the flexures still appeared from time to time. At the age of seventeen months, she was given fish for the first time in her life, and within a few hours the face became swollen and the body and limbs covered with large white wheals, which in every way resembled those of urticaria as seen in the adult. The whole condition rapidly subsided, leaving behind no trace. At the age of twenty months, she began to suffer from papular urticaria, although she was not then having fish. In order to decide whether this was a case of urticaria which had changed its form, fish was again administered, and again there was the same acute outbreak of true urticaria, which, as before, rapidly subsided without the slightest evidence of papule formation.

It must be concluded, therefore, that although papular urticaria has certain features in common with true urticaria, it is essentially a different reaction, and the assumption of a common aetiology is not justified.

Among Continental authors it is customary to class papular urticaria as a prurigo, and it has been suggested from time to time that it is an early stage of the prurigo of Hebra. There are, however, important differences between these two conditions. Heath has pointed out that the eruption on the limbs is much more rigidly restricted to the extensor surfaces in Hebra's prurigo. Whitfield has emphasized the early appearance of secondary skin changes in Hebra's prurigo and their absence in papular urticaria, even in cases of long standing. Both conditions show a seasonal variation, but whereas Hebra's prurigo is said to improve during the summer, papular urticaria usually gets worse at this time. Most important is the difference between the individual papules in the two diseases. The early papule of Hebra's prurigo is deeply set, being more easily detected by touch than by sight; that of papular urticaria is superficial, and is usually capped by a minute vesicle. Not only is this difference apparent clinically, but Civatte has demonstrated it clearly from the histological standpoint.

It is clear, therefore, that papular urticaria is a distinct morbid condition, separable from urticaria and from the prurigo of Hebra. In the evolution of its lesions an urticarial reaction does occur, but there is an additional element, the papule. This papule cannot be evoked by the urticaria-producing agent, H-substance, and it is of a different nature from the papule of Hebra's prurigo : the physiological significance of its formation is not understood.

Incidence of papular urticaria.

Papular urticaria appears to be a common complaint in Great Britain and on the continent of Europe, especially in France, Germany and Denmark : it is comparatively rare in the United States of America (Duhring, Montgomery).

It is very prevalent in Birmingham, as in most large English towns, and, during the period under review, accounted for over sixteen per cent. of all the cases admitted to the Skin Department at the Children's Hospital (table 1).

TABLE 1.

YEARLY INCIDENCE OF PAPULAR URTICARIA, 1930-1934.

YEAR.	NUMBER OF CASES.	PER CENT. OF ALL SKIN CASES.
1930	74	18.9
1931	93	18
1932	87	16
1933	45	11.8
TOTAL	299	16.4

It will be noticed that there was a striking decrease of papular urticaria in 1933, an unexpected finding in view of the hot summer of that year. These figures give no more than a rough impression of the true incidence of the complaint among the whole child population; there is no doubt that medical advice is sought in only a minority of cases.

Sex incidence.—The sexes were almost equally represented, there being 154 boys and 145 girls.

Age incidence.—The youngest patient seen was aged one month, the oldest eleven years. The earliest age at which the rash was said to have commenced was three days, the latest seven years. The disease often begins mildly and insidiously, and many parents, disregarding the first few attacks, were unable to state the age of onset with precision. Most, however, could place the onset within a period of three months. The age of onset was determined with this degree of accuracy in 250 cases (table 2).

TABLE 2.

AGE INCIDENCE OF PAPULAR URTICARIA.

YEARS.	AGE AT ONSET.		AGE ON ADMISSION TO HOSPITAL.	
	NO. OF CASES.	PER CENT.	NO. OF CASES.	PER CENT.
0— 1	125	50	41	13.7
1— 2	68	27.2	65	21.7
2— 3	31	12.4	80	26.7
3— 4	14	5.6	41	13.7
4— 5	5	2.0	25	8.4
5— 6	2	0.8	14	4.7
6— 7	4	1.6	11	3.7
7— 8	1	0.4	7	2.3
8— 9	—	—	7	2.3
9—10	—	—	6	2.0
10—11	—	—	1	0.3
11—12	—	—	1	0.3
TOTALS	250		299	

It will be seen that the disease begins most commonly (50 per cent. of cases) during the first year of life, and very rarely after the fourth year. A further analysis shows that the onset is especially common during the first nine months of life, and that there is an appreciable increase in the frequency of its occurrence between the ages of six and nine months, the period when teething commonly begins (table 3).

TABLE 3.

ONSET OF PAPULAR URTICARIA DURING THE FIRST YEAR OF LIFE.

AGE PERIOD.	NUMBER OF CASES.	PER CENT.
0— 3 MONTHS	28	22.4
3— 6 ,,	32	25.6
6— 9 ,,	43	34.4
9—12 ,,	22	17.6
TOTAL	125	

The age on admission to hospital is of some importance because it seems reasonable to assume that most patients are brought when the disease is at its worst. Table 2 shows that the great majority of patients were under the age of four years on their first attendance at hospital, and nearly half were aged between twelve months and three years.

It may be concluded, therefore, that papular urticaria, although not strictly confined to any special age period, is essentially a disease of the first four years, beginning most frequently during the first nine months of life, and attaining its maximum severity during the second and third years.

Seasonal incidence.—Attacks may occur at any time of the year, but the disease is much more prevalent in summer than in winter. The month in which the first attack occurred was determined in 158 cases. Of these, 101 (64 per cent.) had their first onset during the six warmer months, April to September, and 57 (36 per cent.) during the six colder months, October to March. The seasonal incidence is not entirely attributable to the higher temperature of summer. The monthly admissions for papular urticaria, which may be taken as a guide to the

seasonal variations in its severity, are shown in fig. 1, and are compared with the mean monthly temperatures over the same period.

There was a distinct bi-annual rise in the number of admissions, most patients attending for the first time in September, and the next highest number in late spring. It is obvious that no strict correlation exists between the atmospheric temperature and the prevalence of papular urticaria.

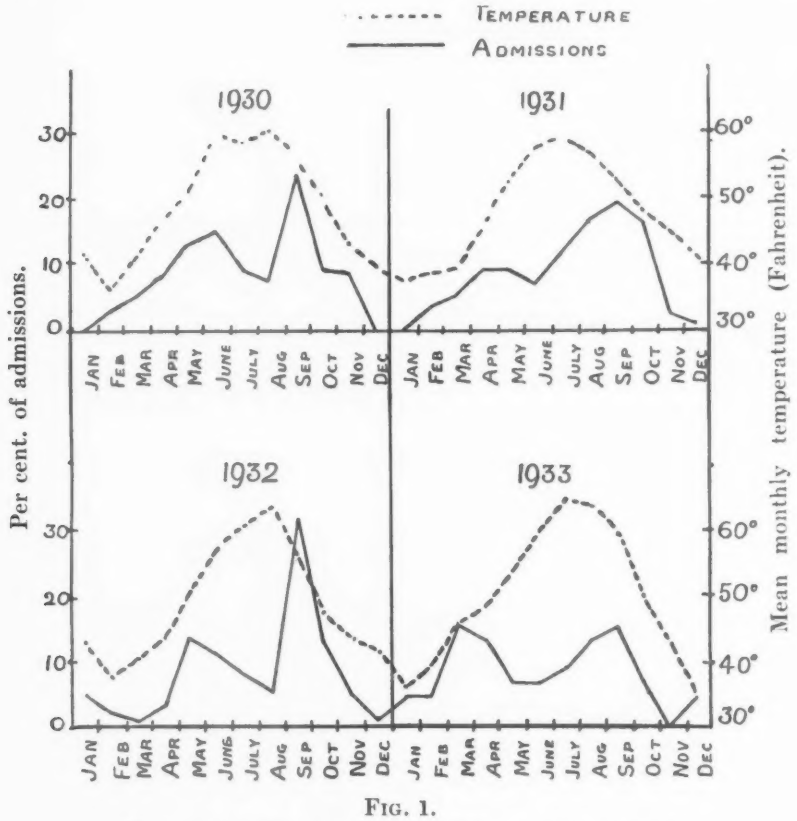

FIG. 1.

MONTHLY ADMISSIONS IN RELATION TO TEMPERATURE.

There does, however, seem to be some connection with diet. Late spring and early autumn, the periods when the admissions are greatest, are also periods when the carbohydrate content of the diet tends to be increased, especially among the poor. These are the seasons when stewed fruit becomes cheap and therefore popular—rhubarb in late spring, plums, blackberries, etc., in early autumn—and these dishes are served with large amounts of sugar. In early autumn, fresh fruit also becomes plentiful, so that the carbohydrates of the diet are still further increased; and in addition, although the atmospheric temperature is falling, it still reaches levels high enough to affect the disease.

Haxthausen found that in Copenhagen, there was a big increase in the number of cases coincident with the period of ripening of the commoner fruits. He was unable to demonstrate any direct connection between the prevalence of the disease and weather conditions.

Social status. — The worst cases occurred among the poorer patients, but many came from comparatively good homes. Of the present series of patients 82 per cent. belonged to families of three or less children, and 35 per cent. were only children : in these cases poverty or parental neglect are unlikely to be major factors. There is no doubt that the disease is of frequent occurrence in all social grades.

Diathesis.

Since papular urticaria is commonly held to be allergic, the personal and family histories of the patients were investigated for other manifestations of allergy. Inquiries were made into the personal histories for symptoms of eczema, asthma and, in older children, hay fever. The family histories were examined for eczema, urticaria, asthma, hay fever, and migraine. A fairly complete personal history was forthcoming in 270 cases, but the family history was not taken in the earlier stages of the inquiry, and was obtained in only 208 cases. The results may be summarized thus :—

Personal History.

Total number of cases 270

Of these, a history of allergic diseases was given in 4, or 1.5 per cent.

These comprised :—

Infantile facial eczema	1 case
Flexural eczema (Besnier's prurigo) ...	2 cases
Asthma	1 case

No special inquiry was made for enuresis, which Bray includes as an allergic condition, and which he believes to be commonly associated with papular urticaria, but a history of this complaint was volunteered in only seven cases (2.6 per cent.).

Family History.

Total number of cases 208

Of these, a history of allergic diseases was obtained in 29 or 13.9 per cent.

These comprised :—

Eczema	in 13 cases
Urticaria (or angio-neurotic oedema) ...	,, 4 ,,
Asthma	,, 12 ,,
Hay fever	,, 7 ,,
Migraine	,, 2 ,,

If eczema be excluded, it is found that only 9.6 per cent. of cases had a family history of allergic disease, while if only asthma and hay fever be considered, this figure is reduced to 8.6 per cent.

These figures approximate very closely to those obtained by other observers for normal persons, and are in striking contrast to those for a

series of asthmatics. Spain and Cooke, considering asthma and hay fever only, obtained a positive family history of allergy in 7 per cent. of a series of 115 normal persons; Balyeat in 8.3 per cent. of a series of 1,117 normal persons. Cooke and Vander Veer, including urticaria, angio-neurotic oedema and gastro-intestinal allergy in addition to asthma and hay fever, obtained a positive family history in 12.2 per cent. of 139 normal cases. In Bray's series of 200 asthmatic children on the other hand, there was a positive family history of allergy in 68.5 per cent. O'Keefe and Rackemann, while not specifying what diseases they counted as allergic, stated that there was a positive family history in 28 per cent. of 212 cases of eczema in children.

It appears from these figures that the occurrence of other allergic manifestations, either in the personal history or in the family history, of patients with papular urticaria, is no more frequent than in a series of normal people.

A further point of importance in this connection is the sex incidence. It has repeatedly been shown that both eczema and asthma, when occurring in early childhood, affect boys more often than girls in the proportion of about 3 :1. Papular urticaria affects the sexes equally.

It is improbable, therefore, that there can be a hereditary predisposition common to papular urticaria and the other allergic diseases; nor does there seem to be any adequate reason for including the condition in either the so-called exudative or neuro-arthritic diathesis.

Association with other conditions.

Teething.—In 10 per cent. of patients the rash first appeared before the age of three months, and in a further 10 per cent. after the age of three years; that is, in 20 per cent. of cases teething can be definitely excluded as a cause of the disorder. In 37 per cent. of cases the rash persisted after dentition was complete. Nevertheless the onset of the complaint does seem to occur with greater frequency between the ages of six and nine months, the period when teething commonly begins, than during any other age period of like duration (see table 3). Further, in several cases the parents were quite sure that not only did the onset of dentition determine the onset of the rash, but also that the cutting of each subsequent tooth caused an exacerbation.

Darier, who ascribes a good deal of importance to dentition in this complaint, maintains that an outbreak of the rash is not uncommon during the cutting of the wisdom teeth. In my experience papular urticaria is rare at this period of life, but I have seen it in a girl of seventeen : and in this patient the lower wisdom teeth were just appearing. It seems probable, therefore, that dentition is a definite predisposing factor in some cases.

Digestive disorders.—A history of digestive disturbances was volunteered by the parents in only a few cases, but because of the opinions so

frequently expressed in the literature, detailed inquiries for symptoms referable to the alimentary system were made in 150 cases :—

Total number of cases ...	150	
Negative history	125 cases	or 83.3 per cent.
Positive history	25 cases	or 16.7 per cent.

The symptoms complained of comprised :—

Constipation	9	cases
Constipation alternating with diarrhoea	5	,,
Diarrhoea	4	,,
Vomiting	5	,,
Coeliac disease	2	,,
Total	25	,,

It is very difficult to estimate the significance of these findings. Constipation is common enough throughout life, while attacks of vomiting and diarrhoea are frequent accidents of childhood, so that their occurrence in association with such a common disease as papular urticaria is not surprising. Neither Czerny, Karplus, Hallam nor Winkler observed any great prevalence of digestive disorders among their patients. Corson and his co-workers, in a study of 31 cases, found the state of nutrition of the children good, the appetite healthy, and in 21 cases the bowels were regular.

Sometimes, however, there does seem to be a definite relation between the alimentary symptoms and the rash, as in one case where the mother stated that each fresh outbreak was always heralded by vomiting. It seems probable, therefore, that digestive disorders may predispose to papular urticaria, but it is obvious that their importance in this respect has usually been greatly overestimated.

Intestinal worms.—A history of threadworms was elicited in four cases only. In one of these, the worms had been discovered and treated five months before the onset of the rash. Corson found threadworms in the faeces of only one out of 31 cases; Hallam in only one of 51 cases. Hellsten finds that, in children, the incidence of threadworm infestation increases with age, reaching a maximum between the ages of 10 and 15 years. Papular urticaria on the other hand, decreases with advancing years. There can be little doubt, therefore, that the occurrence of threadworms in association with papular urticaria is purely fortuitous.

Febrile disturbances.—In twelve cases the onset of the rash was thought by the parents to be related to the following conditions :—vaccination in five cases; varicella in three cases; measles in two cases; and diphtheria in two cases.

The rash first appeared a week after vaccination in each of the patients where this was held responsible, but showed no definite time relationship to the other conditions.

In no patient admitted to hospital was bacilluria discovered, nor was this found by either Hallam or Corson in any of their patients.

I have no statistics relating to the occurrence of colds among my patients. It is significant that papular urticaria begins most frequently, and is usually most severe, during the summer months, when colds are not specially rife.

The short interval elapsing between the onset of the rash and vaccination suggests that there may be some connection between the two condtions. Parents, however, are only too ready to blame vaccination for any childish ailment, and the fact that it was incriminated in so few cases shows that it can, at the most, be of only very minor importance. The evidence relating to other febrile disturbances is entirely unconvincing.

Evidence relating to diet.

The diet of patients under the age of nine months.—Of the 250 cases in which the age of onset was determined, the symptoms commenced during the first nine months of life in 103, i.e., 41 per cent. In twelve of these, no record of the diet was kept. The mode of feeding at the onset of the complaint in the other 91 patients is set forth, together with a control series, in table 4. As a control, the diets of 100 infants, under the age of nine months, who attended hospital for naevi and for certain surgical conditions such as burns, scalds, fractures and hernia were investigated.

TABLE 4.

Nature of Diet.	Patients with Papular Urticaria (91 cases). Per cent.	Controls. (100 cases.) Per cent.
Breast only	42.9	45
Breast with supplementary feeds ...	3.3	2
Artificial feeds only	53.8	53

It will be seen that the figures for the two groups approximate so closely that it may reasonably be concluded that papular urticaria attacks indiscriminately both breast-fed and bottle-fed infants under the age of nine months. Since this is the period when the onset of the complaint occurs with the greatest frequency, these findings furnish strong evidence that diet can play no more than a minor part in the aetiology.

The diet of older patients.—It was impossible to keep an accurate record of the children's diets after the age of about nine months, but the opinion was formed that in many instances, and especially among the poorer patients, the carbohydrate intake was unduly high.

In most cases, inquiries were made to find out whether or not the onset, or exacerbations, of the symptoms seemed to be related to the administration of particular foods. In only 29 instances were the parents definitely of opinion that diet had any influence, but a consideration of the foods incriminated is rather instructive. They were as follows, the figures in brackets being the number of cases:—bananas (12); apples (7); oranges (1); fresh fruit (any kind) (1); stewed fruit (2); tinned fruit (2);

sweets and sugar (7); cake (2); shredded wheat (3); porridge (1); new bread (1); fish (3); cod liver oil (2); and bacon fat (1).

The striking feature of this list is the frequency with which foods of a high carbohydrate content occur; and in every case where the food was of this nature, its removal from the diet, together with a restriction of carbohydrate in general, was followed by rapid improvement. Further, a great improvement was noticed in many other patients on a restricted carbohydrate diet, even when no particular food had been blamed by the parents; and the improvement, in chronic cases, is frequently so rapid that it does not seem possible to ascribe it to any other cause. Moreover, in some cases, after apparent cure, it was possible to provoke the eruption again by re-introducing large amounts of carbohydrate into the diet, a phenomenon which has also been observed by Mathieu and his co-workers. This is well illustrated by the following case :—

> B.H., a male, was first brought to hospital at the age of three years in August, 1931, with a history of frequent attacks of papular urticaria since the age of nine months. It was noticed that the eruption always seemed worse after bananas and shredded wheat. These were excluded from the diet, the carbohydrate intake generally restricted, and a soda and rhubarb mixture was given. There was an obvious improvement, and by October the lesions had ceased to appear. In January, 1932, porridge was added to the diet, and a fresh outbreak occurred immediately. Porridge was discontinued, and by the middle of February the boy was well. On March 24 there was a very profuse outbreak, and, on inquiry, it was found that the previous day was the boy's birthday, in the celebration of which he had eaten large quantities of sweets and cakes. Dietetic restrictions were again observed, and by the middle of April recovery seemed complete. In June there was a further slight attack, for which no dietetic cause was discovered. In August the inclusion of stewed plums in the diet was followed by another severe outbreak of the rash. Rapid improvement again occurred when this food was omitted; and, except for a very few occasional lesions, not sufficient to cause the boy any discomfort or the parents any anxiety, he has remained well since.

In this patient it will be noticed that outbreaks of the rash occurred even when the diet was regulated, but they were never so severe as those which occurred after the addition of extra carbohydrate to the diet. It is also instructive to note that a variety of foods seemed to precipitate an attack—bananas, shredded wheat, porridge, sweets, cakes and stewed plums—and the one feature common to them all is their high carbohydrate content.

Crocker, Mathieu, Weigart and Gray all mention excessive carbohydrate feeding as a cause of the disease. The harmful influence of bananas has been observed by Burgess, and Walker has blamed stewed rhubarb, a food which is always served with a large amount of sugar. These findings account, in part at any rate, for the seasonal variations in the severity of the disease.

The mode of action of these carbohydrate foods is obscure. It seems to be a quantitative effect, not an allergic phenomenon. Symptoms of digestive disorder were present in only 16.7 per cent. of cases; and in several instances, selected at random, the stools showed no excess of organic acids, and no evidence of excessive fermentation, so that Mathieu's ' acid ' colitis hypothesis is untenable.

It must be emphasized that overfeeding with carbohydrate is not an essential and constant factor in the disease. Breast-fed infants are attacked, and in some of the older children, careful dieting fails to produce any improvement. It is very unlikely, therefore, that in severe cases, such as Hallam investigated, their recovery on admission to a hospital ward could be due to a mere quantitative change in the carbohydrate content of the diet. Nevertheless, in experimental attempts to provoke the eruption, it would seem advisable to provide the children with a liberal carbohydrate ration.

Vitamin deficiency.—The foregoing analysis does not suggest vitamin deficiency as an important factor in papular urticaria, but Funk and Grundzach, and Comby have reported a frequent association with rickets. Slight rickets is notoriously difficult to diagnose clinically. Radiological examination of three of the present series of patients, in whom rickets was suspected, showed normal bones. No attempt has been made to estimate the precise incidence of rickets in the present series. Clinically discernible rickets was not common. There are three further points which suggest that there is no connection between the two diseases. Papular urticaria frequently begins during the first nine months of life, and at this age period breast feeding seems to offer no protection. Secondly, although the age incidence of papular urticaria overlaps that of rickets, it is not identical. Park and Eliot conclude that ' rickets in its active form is essentially over by the end of the third year.' Papular urticaria frequently lasts much longer; in the present series 38 per cent. of the patients were over three years of age on their first attendance at hospital. Finally, and perhaps most important, is the seasonal incidence. Chisholm has shown that in Manchester, and presumably the same would hold for similar English cities, rickets is most prevalent in late spring, and becomes less and less frequent as the summer advances, reaching a minimum in autumn. Papular urticaria on the other hand, has always been recognized as a disease of the summer months, and in the present series the attendances at hospital reached their highest peak in September.

Food allergy.—If the disease were a manifestation of food allergy, it would be necessary to assume that the breast-fed patients are sensitive either to human milk, or to something excreted in it.

Shannon claims to have shown, both by anaphylactic experiments on guinea pigs, and by clinical tests, that proteins eaten by women can be excreted in the breast milk and produce cutaneous symptoms in the suckling. His methods have been adversely criticized by Stuart, who was unable to demonstrate any excretion of foreign proteins in breast

milk. Gebert and Lortat-Jacob attributed the disease in breast-fed infants to changes in the breast milk caused by menstruation in the mother. Sensitivity to human milk, however, whether normal or altered by menstruation, and sensitivity to any foreign proteins it may contain, seems highly improbable, for in none of the present series of patients, and in none of Hallam's, did weaning effect a cure.

No improvement was observed as a result of dietetic measures other than carbohydrate restriction. In two cases cod-liver oil, and in one case bacon fat, were thought to precipitate the attacks, but the exclusion of these articles from the diet was without effect. In view of Bray's hypothesis, complete exclusion of all pork products was advised in fifteen cases, but no benefit accrued. In three cases fish was held responsible, but the rash still appeared after the complete withdrawal of this food.

It may be said, in summing up this section, that careful inquiry and the elimination of suspected foods from the diet failed to provide any satisfactory evidence that papular urticaria is caused by food allergy. There are, however, two weak points in this type of investigation. First, if there were a long latent period between the ingestion of the allergen and the manifestation of the allergic reaction, the association between the two might escape notice; secondly, parents cannot always be relied upon to carry out dietetic restrictions. In order to obviate the first of these difficulties, cutaneous tests have been tried, but while several authors have reported an increased cutaneous sensitivity to proteins in papular urticaria, all agree, with the exception of Sidlick and Knowles, whose results are not convincing, that the tests are of no diagnostic value.

It seems, therefore, that the only satisfactory way of demonstrating that the disease is a manifestation of food allergy, is to provoke the eruption, by food, under controlled conditions.

Experimental evidence.

1. **The effect of heat.** — In order to investigate the effect of heat, out-patients were chosen whose rash was not very profuse, and who had developed fresh lesions on the previous day but none on the day of attendance. These patients were placed in a room which was heated to different temperatures, and examined from time to time, old papules having been previously marked. The patients were clothed, but kept at rest during the experiment. They were tested as soon as possible after arrival at hospital, for it was considered that, once having left their homes, they had almost certainly left behind them the real cause of the disease, whether this were food or not; and delay might therefore vitiate the experiment. Accordingly each patient could serve for one experiment only. In some ways it would be preferable to test each patient to a series of different temperatures for it is possible that those who did not react at the lower temperatures would not have done so at the higher.

Eight observations were made, the results of which are shown in the following table :—

TABLE 5.

Case	Room Temperature. Degrees F.	Duration of Exposure.	Result.
I.C.	64	1 hour	No fresh lesions.
D.R.	65	,,	No fresh lesions.
B.H.	67	,,	No fresh lesions.
R.M.	68	,,	One fresh wheal.
R.A.	68	,,	Three fresh wheals.
W.W.	68	,,	Many fresh wheals.
G.B.	70	,,	Few fresh wheals.
I.A.	70	15 minutes	Many fresh wheals.

It will be observed that all the patients exposed to 68° F. or more, developed fresh lesions, whereas the other three did not. It therefore appears that, with the patients at rest, a minimum atmospheric temperature of 68° F. may be necessary to evoke the lesions; and we are not justified in drawing any definite conclusions from the results of admitting patients to ordinary hospital wards, the temperature of which is usually only about 60° F., and rarely exceeds 65° F.

2. Diet and digestive disorders.—Seventeen children, all chronic cases of long duration, were admitted to hospital. One patient was admitted twice, and another on three occasions, thus making a total of twenty admissions. The room in which they were accommodated was small, containing three beds and separated from the main ward. It was found impossible to keep the temperature constant, but it was raised daily to over 68° F. In eleven cases admitted during the summer months, the atmospheric temperature presented no difficulty; it regularly exceeded 70° F., frequently reaching 80° F., and even 90° F. on occasions.

In each case an attempt was made to reproduce the diet which the patient usually received when at home. In order to insure their receiving an adequate supply of carbohydrate, all the children except one were given bananas, chocolate and porridge. In view of Bray's hypothesis, thirteen of them were given bacon daily. One patient received cod-liver oil, because this had been incriminated by the parents. The shortest stay in hospital was eight days, the longest seven weeks. Two patients showed a tendency to constipation, two had an attack of diarrhoea, and two an attack of vomiting while in hospital. One patient, a girl, aged seven and a half months, was admitted with severe diarrhoea which persisted for some weeks. In this case no doubt whatever need be entertained that the home diet was accurately reproduced in hospital.

In not a single instance did fresh lesions develop during the course of the experiment. The recovery of these cases cannot have been mere coincidence, for in all of them fresh lesions were appearing daily prior to their admission to hospital and relapse occurred when they were discharged, in two cases on the following day, in four cases two days after, and in three cases three days after discharge. Recovery was not due to an inadequate atmospheric temperature, nor to a diminution of the

carbohydrate content of the diet. The patient with diarrhoea, and the two with constipation were specially chosen on account of these symptoms. These digestive disorders did not show the same dramatic improvement as the rash and therefore cannot be regarded as the exciting causes. The patient with diarrhoea was specially interesting. She was in hospital for seven weeks, during which time no fresh lesions occurred. Yet, although the diarrhoea had ceased, she developed a fresh crop of papules the day after her discharge. Allergy to pork fat seems to be out of the question, since thirteen of the patients were given bacon, while another patient had never received any pork in her life.

It is admittedly difficult to be absolutely certain that the home diet is reproduced with perfect accuracy. These experiments show, however, that the number of foods which could be responsible for the symptoms in any one case must be strictly limited. Yet, that being so, why is it so very difficult to detect the offenders by careful history taking? Further, it must be emphasized that papular urticaria is of so frequent occurrence that the foods responsible, if food allergy were indeed the cause, must be common articles of diet and it is almost inconceivable that the particular food should have been overlooked in every one of these experiments. There seems, indeed, hardly room for doubt that papular urticaria is not a manifestation of food allergy; the cause must be sought in the child's environment.

3. **Environmental influences.**—In the following experiments, the same precautions as before were observed with regard to ward temperature, and the carbohydrate content of the diet.

Bedding.—In two cases bedding from the patients' homes was substituted for the usual hospital bedding. In one case the test was completely negative, and it is therefore unlikely that the bedding was the cause of the symptoms when the child was at home. In the second case a positive result was obtained :—

> B.G., a male, aged seven years, had been subject to papular urticaria for five years. The rash was profuse, especially on the limbs and back, and a few lesions were present on the face. He was admitted to hospital on June 26, 1933, and in addition to the ordinary hospital diet, he was given bacon, chocolate, bananas and porridge. There was an immediate improvement, no fresh wheals appearing. On July 5 bacon was discontinued. On July 7 bedding from home was substituted for the hospital bedding. On the following day well-marked fresh lesions of papular urticaria were present. He continued to sleep on this bedding for a further ten days, but although the ward temperature was kept high, reaching 75° F. on occasions, no further outbreak occurred. On the second day after his return home, however, fresh wheals were observed.

Here, one crop of fresh papules appeared. It is tempting to incriminate the bedding, but if that were responsible, it seems strange that only one attack occurred during the boy's stay in hospital, whereas fresh

wheals were appearing almost daily when he was at home. It seems much more likely that the boy was sensitive, not to the actual bedding, but to something which was carried into hospital with it; and this agent was removed by the making of the bed and cleaning of the ward.

In one other instance I have witnessed an outbreak of papular urticaria during a patient's stay in hospital. This I saw by the courtesy of Prof. L. G. Parsons.

> N.J., a male, aged four years, suffering from osteogenesis imperfecta, was admitted to the General Hospital, Birmingham, on September 3, 1933. On the morning of October 4 the cutaneous eruption was observed. The lesions were scattered over the forearms, legs, and back, and appeared in every way typical of papular urticaria. A careful inquiry showed that there had been no change from the ordinary hospital diet and the administration of the same food on subsequent days was without any untoward effect. It was discovered, however, that on the day preceding the outbreak of the rash, a woollen vest, pyjamas and dressing jacket had been brought from home, and these the boy had worn during the rest of that day. He continued to wear them for several more days, but no further lesions appeared.

In this case, the outbreak of the rash seemed to be definitely related to the wearing of clothes brought from home, and, in view of the other experiences, this association of events cannot be dismissed as pure coincidence. Yet here again, it seems unlikely that the clothes themselves were responsible, because, although the patient wore them for several days, there was only one crop of papules. Hallam made similar tests with bedding in four cases, with a positive result in one. Here a repetition of the test was negative.

In each of three patients, one of Hallam's and the two just described, fresh lesions of papular urticaria have appeared while the patient has been in hospital. In each instance the outbreak occurred only after the patient had slept on bedding, or in clothes, brought from home. Moreover, these are the only cases in which I have known the rash to appear during a patient's stay in hospital, although many other efforts have been made to provoke it. Accordingly there can be little doubt that the attacks were in some way connected with the bedding and clothes. It is unlikely that these articles were themselves responsible for the symptoms, because in each of my two cases there was only one fresh crop of papules, and in Hallam's case, although fresh lesions appeared on several days, a repetition of the experiment gave a negative result. Further, the introduction of home bedding into hospital did not provoke the rash in other cases. The most reasonable conclusion seems to be that the eruption was due to something carried on the bedding and clothes respectively.

The precise nature of this agent remains obscure. The following substances were tested, but with negative results in each case :—

HOUSE DUST.—Sweepings from a patient's bedroom were scattered into the air of the ward, and on to the bed. The experiment was performed once only, and although the ward temperature reached

69° F., it was not maintained at this level. The test will be repeated when a suitable opportunity occurs.

MOULDS.—In three cases, spores of moulds cultured from the air of the bedrooms were scattered above the patients' beds. It cannot be assumed that the growths obtained accounted for the whole mould flora of the bedrooms: while it is evident that the children were not sensitive to moulds in general, sensitivity to a particular mould is not definitely excluded.

SCRAPINGS FROM WALLS AND CEILINGS.—Similar tests were performed with the fine dust obtained by scraping the walls and ceilings of the bedrooms.

ANIMAL SIZE.—This substance was tested because it is present on the walls or ceilings of most houses, and animal emanations are supposed to be among the commoner causes of allergy. Large sheets of paper coated with size were hung round the bars of a cot for several days, and very finely-ground size was scattered into the air of the ward.

Hutchinson and Burnet regarded flea bites as the commonest causes of the disease, and the possibility of insect bites has also been mentioned by Crocker, Barber, Weigart and Boutelier. It is obvious that each individual wheal does not represent a separate bite, because neither flea bites nor bug bites produce the typical papules. Further, it has been shown that, with out-patients, fresh lesions may be evoked simply by raising the atmospheric temperature; it is inconceivable that these children harbour an insect which bites only on the application of warmth. Insect bites could, of course, act indirectly, by introducing some toxin into the blood stream, but the very frequent occurrence of the disease in all grades of society seems to negative such a possibility.

Hallam's discovery that admission of patients to hospital for nights only, relieves the symptoms, excludes sensitization to antigens derived from human beings or domestic animals. The children would be in much closer contact with domestic animals during the day than during the night. With regard to the possibility of antigens derived from human beings, it may be added that several of the present series of patients, when sleeping at home, occupied not only separate beds but also separate bedrooms.

To sum up, all the evidence points to the following conclusions. Some external influence is necessary to provoke the rash. This agent is not a food, but is something in the environment. It is not bedding or clothes, but it can be carried on those articles. It is not vermin, nor an antigen derived from human beings or domestic animals. The evidence relating to house dust, and to moulds or bacteria which it may contain, is inconclusive.

Quite apart from any experiments, it is indeed remarkable that the occurrence of papular urticaria among ordinary patients in children's wards is an event of the greatest rarity. Yet these children are being treated for a great diversity of digestive disorders and febrile illnesses, as well as for rickets and other complaints, and they receive a variety

of diets. Surely this in itself points to some environmental factor as the exciting cause of the disease. It is noteworthy that change of residence, other than admission to hospital, may influence the complaint, as pointed out by Hardy and Kinnear. Nearly all the patients of the present series were living in the houses in which they were born, but in eight cases, change of residence seemed to have a striking effect.

There can be no doubt that sufferers from papular urticaria possess a special sensitivity to the exciting agent; everyone must be familiar with instances where, of two children living under the same conditions and sleeping in the same bed, one develops the eruption and the other remains unaffected. It seems quite justifiable, therefore, to speak of the complaint as an allergic disease, even though the allergen remains undiscovered.

As in other allergic diseases, the sensitivity seems to vary, and in practically all cases it disappears in late childhood.

Papular urticaria shows a further similarity to other allergic diseases in that patients exhibit an increased cutaneous sensitivity to foreign proteins.

In some cases, too, changes in the blood may be observed, which, though not very convincing, are perhaps suggestive of an allergic reaction. These and other blood changes will be briefly discussed in the following paragraphs.

Blood examination.

Haematology.—A leucocyte count was made in ten cases. Fresh wheals were present in all the patients, but the skin lesions can only be regarded as a rough guide to the stage of the reaction (table 6).

TABLE 6

LEUCOCYTE COUNT IN PAPULAR URTICARIA.

CASE	TOTAL LEUCOCYTE COUNT. PER C.MM.	DIFFERENTIAL COUNT, PER CENT. OF WHITE CELLS. POLYMORPHS.	LYMPHOCYTES.	MONOCYTES.	EOSINOPHILS.	BASOPHILS.
E.S.	8,900	44	44	10	2	—
B.G.	13,100	45.5	36	4.5	13.5	0.5
J.Th.	6,550	45.5	40.5	8.0	6.0	—
J.T.	10,050	—	—	—	3	—
R.S.	11,750	58	27	13	2	—
A.G.	10,100	37.5	59.5	2	1	—
P.F.	7,900	29	62.5	5.5	2	1
G.B.	14,500	14	77.5	8	1	—
B.A.	14,200	64	30.5	3.5	2	—
T.A.	8,100	49.5	43	4.0	3.5	—

There was no constant finding; three cases showed a definite lymphocytosis, and two a well-marked eosinophilia. One patient, B.G., who had a high degree of eosinophilia, was admitted to hospital, when two further counts were made, and neither of these revealed any abnormality. It is probable, therefore, that the blood change in this case was directly connected with the presence of the rash, a further point in support of the allergic basis of the disease.

Hallam observed a leucopenia and eosinophilia in four out of five cases; Corson found eosinophilia in seven out of twenty-five cases.

Blood chemistry. AMINO-ACIDS AND CHLORIDES.—It was thought possible that at the height of an attack the blood might show changes similar to those found by Barber and Oriel in other allergic conditions, viz., an increase in the amino-acid value and a reduction of chlorides. Estimations were carried out in thirteen cases, but the results were inconsistent and mainly negative, and the investigation was therefore abandoned. There were a few findings which may be of some significance. As controls, three patients were admitted to hospital and the estimations repeated when the rash had disappeared. Examinations were made also in three cases of mild impetigo. The results are given in table 7.

TABLE 7.

			OUT-PATIENTS: FRESH WHEALS PRESENT.		IN-PATIENTS: NO WHEALS PRESENT.	
CASE.	AGE.	SEX.	AMINO-ACID-N. MGM. PER CENT.	CHLORIDES MGM. PER CENT.	AMINO-ACID-N. MGM. PER CENT.	CHLORIDES MGM. PER CENT.
J.W.	1 yr. 10 mth.	F.	7.18	475		
R.M.	1 yr. 10 mth.	M.	8.48	470		
J.H.	2 years	M.	5.3	362		
E.H.	2 years	F.	7.69	495		
P.D.	2 years	M.	6.51	446		
S.H.	2 years	M.	7.61	231	(i) 6.9 (ii) 8.97	429 462
R.H.	2 yr. 3 mth.	F.	7.87	409		
I.C.	2 yr. 6 mth.	F.	7.53	391		
M.G.	3 years	M.	8.77	495		
J.G.	3 yr. 6 mth.	M.	6.74	461		
B.G.	4 years	M.	8.64	479	10.12	462
R.S.	5 years	M.	8.43	462		
G.C.	6 yr. 6 mth.	M.	7.68	396	9.13	445.5
			Normal controls.			
F.C.	4 years	M.	6.31	495		
A.B.	6 years	F.	9.52	470		
M.Y.	8 years	F.	7.85	465		
		MEANS	7.89	477		

The commonly accepted figure for the normal value of the blood chlorides (whole blood) is 450-495 mgm. per cent. According to Edgar, the figures obtained for the amino-acid nitrogen when estimated by Folin's method—the method adopted here—show variations depending on the strength of the sodium carbonate solution employed. The values obtained in the present series are higher than those of most observers, but are commensurate with those obtained by Edgar. It will be observed that in no case was the presence of wheals associated with any increase of the amino-acid nitrogen, but in five cases there was a definite reduction in the chlorides. Since the variations of the amino-acids and chlorides which occur in allergic reactions are transitory, no conclusions can be drawn from the negative results of single estimations. The lowering of the chlorides, however, may be of some significance and this seems the more probable because in two cases where it was observed, the figures

returned to normal when the rash had subsided. Corson found a slight reduction of the chlorides in twelve out of sixteen cases.

ALKALI RESERVE.—It has been suggested that the administration of alkalies has a beneficial effect in some cases of papular urticaria. The pH of the blood and the alkali reserve were therefore estimated in three cases. The pH was determined electrically, the hydroquinone electrode being employed, and the CO_2 was estimated by van Slyke's method.

In one case two estimations were carried out, one on the morning following the child's admission to hospital, the second on the day of discharge. In the other two cases a single estimation was made when the child had been in hospital a week. In each instance the blood was collected after a twelve hours' fast. The results are summarized in table 8.

TABLE 8.

ALKALI RESERVE IN PAPULAR URTICARIA.

CASE.	AGE.	SEX.	pH.	CO_2	REMARKS.
D.R.	4 years	M.	(i) 7.53 (ii) 7.56	22 millimols 25.6 ,,	Fresh wheals two days after discharge.
B.G.	7 years	M.	(i) 7.53	22.5 ,,	Fresh wheals day after discharge.
T.B.	9 years	M.	7.41	27 ,,	Fresh wheals two days after discharge.

Normal values were obtained in each case, yet each relapsed almost immediately after his discharge from hospital. It is obvious, therefore, that a lowered alkali reserve is in no wise an essential condition for the development of papular urticaria and a normal alkali reserve seems to afford no protection.

Treatment.

Many children suffer from transient attacks of papular urticaria, and recover without treatment, an important fact which must always be borne in mind in any attempt to estimate the value of a particular remedy. Treatment is tested by the chronic cases, and, only too frequently, it proves far from satisfactory.

Since heat has such a profound influence on the symptoms, much can often be accomplished by attention to clothing and to ventilation of the patients' bedrooms. Most authors advocate dietetic treatment, but many are extremely vague in their instructions, while some give advice diametrically opposed to that of others. I am convinced that in many cases restriction of the carbohydrate content of the diet has a very beneficial effect.

It is customary to prescibe medicine, if only for the peace of mind of the parents. In this country, soda and rhubarb seems to be the traditional remedy. Thus, Lancashire writes, ' If I had the choice of one drug only it would be rhubarb and soda.' I have prescribed such a mixture in the majority of my cases, and its administration has frequently been followed by improvement. In some cases, at any rate, the benefit was probably due to the medicine, since the substitution of other drugs was followed by relapse, improvement occurring again on the re-administra-

tion of soda and rhubarb. Paterson advises large doses of sodium bicarbonate. Bray gives hydrochloric acid and pepsin, although, if, as he states, the disease were a manifestation of fat allergy, the rationale of this mixture is somewhat obscure. The observations which I have recorded on the alkali reserve, while in no way conclusive, are perhaps a little suggestive that neither alkaline nor acid therapy is likely to be of much value.

Calcium is not infrequently given, although blood analysis shows a normal serum calcium in most cases. Cornbleet advises injections of parathyroid extract combined with the oral administration of calcium lactate in large amounts. Such treatment would increase the serum calcium even if the calcium lactate were omitted. Another method which would tend to increase the serum calcium is the production of an acidosis. I gave calcium chloride, 10 grains three times a day, to two patients (aged three years and three years nine months respectively) but the parents of both stated that the symptoms were aggravated by the treatment. I have never seen benefit accrue from the administration of other calcium compounds in ordinary doses. Darier and van Vonno prescribe atophan, but it is a drug not free from danger and its use in a relatively harmless disease does not seem justifiable. Desensitization with peptone has been attempted, and Urbach claims a high degree of success for his propeptan method. Good results have been recorded also by Pasteur Vallery-Radot and Blamoutier, from the oral administration of less specific peptones, and by Mathieu, Levy and Lautman from the intradermic injection of Witte's peptone.

Admission of patients to hospital always brings relief, and in my cases, although relapse occurred when they returned home, the symptoms were much less severe than before. This seems to be by far the most valuable therapeutic measure in all those severe and persistent cases where the general health suffers from the continual irritation and loss of sleep.

Conclusions.

1. Papular urticaria is a definite and distinct syndrome, separable from urticaria and from Hebra's prurigo.
2. It is a manifestation of allergy.
3. It is essentially a disorder of the first four years of life.
4. It is aggravated by heat, and by a diet containing too much carbohydrate.
5. Digestive disorders, teething and mild febrile disturbances probably predispose to papular urticaria, but such conditions are of very minor importance in its aetiology. Rickets plays no part.
6. There is no satisfactory evidence of any underlying diathesis.
7. The exciting agent is not a food.
8. The exciting agent is something connected with the patients' home environment, but its precise nature remains obscure. It is not bedding or clothes, but it can be carried on these articles. It is not

vermin, animal-size, nor an antigen derived from human beings or domestic animals. Sensitivity to house-dust has not been definitely excluded.

I am greatly indebted to Miss Hickmans, Ph.D., Biochemist to the Children's Hospital, for the biochemical estimations, and to Dr. J. C. Hawksley, late Research Scholar at the Hospital, for the blood counts. My thanks are also due to the nursing and administrative Staffs for their helpful co-operation in the experimental investigations.

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OBSESSIVE-COMPULSIVE STATES IN CHILDHOOD AND THEIR TREATMENT

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The object of this paper is to discuss a problem with which consultant and general practitioner are alike faced, and to deal with the subject from the standpoint of general medicine in language from which, so far as possible, the more advanced psychological terminology has been eliminated. When it is realized that, failing correct and adequate treatment, compulsive states may persist throughout life, the importance of their recognition and treatment in childhood need hardly be stressed. It is not perhaps generally known that the cure of the obsessive states of childhood is one of the most satisfying, and even dramatic, things in medicine; one of the too few instances in which psychological treatment approaches the realms of an exact science. Arising, as they do, from fear and uncertainty, mild, fleeting compulsive acts are relatively common in childhood and respond readily to simple reassurance or to explanations which undermine the child's fears and satisfy his doubts. From time to time, however, the aid of the practitioner is sought in cases of obsessive-compulsive neuroses which are of such intensity and permanence that the child is not only prevented from attending school or associating with other children, but is the despair of his parents, who, as daily observers of what appear to them to be unnecessary and meaningless repetitions and ceremonials, cannot conceal their disapproval or refrain from outspoken criticism of his behaviour.

Aetiology.

In the majority of cases there is a psychopathic family history, and parents will often describe similar symptoms which occurred in their own childhood and which are attributed by them to a sensitive, worrying and over-conscientious nature. Boys and girls are affected with equal frequency. Symptoms may show themselves so soon as the child is old enough to associate freely with other children and may make their first appearance at any time during school days. The child so affected is invariably sensitive, timid, imaginative by nature, with a fully-developed moral sense. The degree of development in general intelligence does not appear to be a contributing factor in that both the dull and the highly intelligent child may suffer equally. A characteristic feature of the personality make-up of such patients appears to be the ease and readiness with which they are able to express themselves in writing whether it be in prose or in verse.

Symptoms.

The condition is best portrayed by description of actual clinical cases; two typical examples are therefore given in some detail for purpose of illustration.

A., a girl, aged twelve and a half years, was the elder of two children of artisan parents, the younger child being a boy. Her birth was instrumental and was followed by convulsions during the first few days of life, after which development and health were normal until she was four and a half years old. About this time the girl developed peculiarities which were diagnosed as chorea. She would stop suddenly in the street and put her hands above her head. She would knock her hands against her chest until she was bruised. She would make peculiar grunting sounds. She became hysterical, cried if she was spoken to, screamed if she could not have her own way. These symptoms persisted continuously for eight years in spite of long periods of residence in hospital and of convalescent treatment. During the twelve months prior to her first attendance the symptoms had become gradually more pronounced. The patient had bouts of hysterical sobbing and screaming, was sensitive to correction, had attacks of enforced activity during which she was compelled to skip every third step in walking, or do what her mother called ' a bit of a step-dance,' to cough repeatedly, to sneeze violently, make grunting sounds or repeat obscene words and phrases. These forms of activity became more pronounced at night and prevented the girl from obtaining sleep until the early hours of the morning. She would repeat some phrase such as ' good-night ' or what her mother described as ' the back end of a scream,' a thousand times until she fell asleep exhausted. Her state was one of chronic excitement. She could keep no information to herself. If she heard news or gossip in the street she was compelled to run home immediately and repeat it to her mother. If she saw a person spit or blow their nose she felt compelled not only to do likewise but to repeat the action a score of times. When indoors she could not sit still, was continually shouting and kept turning the gas taps off and on. Out of doors she continually stopped in the street in order to skip a step before proceeding on her way. Anything that came into her mind had immediately to be repeated. So bad had her condition become that the parents dare not travel with her in a public vehicle for fear of what she might say or do. She had been unable to attend school for three months, and prior to this had attended only at irregular intervals. Her condition was becoming steadily worse and had culminated in a liability to speak of her developing body in her father's presence with no sense of shame or modesty.

On examination there were no physical signs of chorea or of other organic disease. She was a good-looking, intelligent girl (mental age fourteen years and one month, I.Q. 113) with flushed face, active mind and body and an outspoken manner. The emotional instability described by the parents was revealed in the initial examination, together with the grunts and sneezes which were interjected in her conversation. The girl's feeling

of hopelessness with regard to her condition was summed up in her first words when, on interviewing her in the absence of her parents, she broke out into hysterical weeping and moaned, 'I hate doctors. Why wasn't I made like other girls? Everywhere I've been they've half cured me and turned me out. I'm fed up with it all. Life's not worth living.' After this storm was over, the patient went on to explain that she felt compelled to imitate everything she saw or heard, no matter how vulgar. If she was occupied she could manage to forget her illness, but so soon as her mind was unoccupied for a single minute, as for example in bed at night, it was immediately full of swear words and unclean words that she felt forced to repeat. When she stopped in walking, sneezed, coughed, or screamed, she knew that these actions were mere substitutes for indecent verbal expressions. The patient could remember that she had suffered from similar symptoms since she was six years of age.

B., a boy, aged twelve and a half years, was the second child of respectable working-class parents, his elder brother being seventeen years his senior. When he was six years of age, shortly after he began to attend the local elementary school, he ran in from his play in the street with other boys and stated that he thought he was going to die. On enquiry, his mother found that his playmates had frightened him by telling him things that he had not understood. She reassured him and told him to take little notice of the boys. From this time on he began to change in his manner. From a lively, care-free child he became one who worried constantly about his health and was in daily dread of appendicitis, blood-poisoning, or any other illness which he knew might have a fatal termination. He would not leave his mother's side, refused to play with his school-mates and could not be induced to attend school. His sleep was disturbed by nightmares. He suffered from sensations of collapse during which he felt that his feet would go from under him. At these times the colour left his face, he looked physically ill, he vomited and complained of headache and of tiredness. His symptoms varied in intensity from day to day, but he was never quite normal. His school attendance amounted to no more than two and a half years over a period of six years. When he was eleven years of age, while spending a holiday with some relatives in the country, and sharing a tent with another boy, he was suddenly seized with acute panic and was certain he was about to die. Following this he was noticed to develop a number of habits. For example, he began to touch things twice, to be over-scrupulous about washing his hands, kept going back to see that the tap was turned off, that the door was properly closed. He became fussy about passing water, felt that he must keep going to the lavatory. He was irritable in temper, difficult to please, he found fault with everybody and everything, was sensitive to correction, could not sit still in school and in church or in a place of amusement he would want to jump up and rush out. He was a constant source of anxiety to his parents, not only on account of his behaviour and moodiness, but because he was unable to attend school and showed no promise of being able to retain employment on reaching school-leaving age.

On examination, there was no sign of organic affection. He was an intelligent boy (mental age fourteen years and three months, I.Q. 114), of quiet, reserved manner, displaying outwardly none of the tendencies which had been described by his parents, but the appearance of his eyes and his facial expression spelt anxiety and nervous exhaustion. The boy, describing his own symptoms, explained how the battle between his impulses and his efforts to control them was so severe that it seemed to take all the energy out of him. He described bouts of vomiting, attacks of excessive appetite, frequency of micturition, pains all over the body, heavy feelings as though he could hardly drag one leg after another. He described a heavy, dull feeling in his head, attacks when everything seemed to go black, difficulty in thinking and concentrating. Every pain or sensation suggested some serious disorder. He felt that he would die and go to hell. He was worried because he was not religious enough. He was afraid that he might become a thief, had to keep saying prayers. He felt that he must say his prayers very slowly, and in his effort to prolong them, found that he stammered over the amen. He could not do anything without first being reassured by his mother that no harm would come to him. He kept apologizing to her for errors he had not committed. There were certain chairs that he felt he must not sit on, others he had to tip up, or blow the dust from before he sat down, and spots where he dare not stand. On attempting to read he could not begin a new chapter, a new page, a new line. He felt that it would be a sin to omit to comply with these forces, and to resist them was like trying to put his hand into scalding water. He dreamt of red devils, black boxes, coffins, and of being swept along the street with the refuse. He had pictures of Jesus in his mind which he could not remove. He had to keep pressing his thumbs together, keep breathing out, keep praying. His life was a nightmare.

Although the cases are similar in their general conformation, each seems to have its own particular characteristic. It seems, too, from the cases investigated and treated by the writer, that the actual form of the symptoms depends to a certain extent on the temperament of the patient. The child who is of extraverted temperament, as for example the first case described in this paper, who is warm-hearted, sociable, and an expender of energy, very much in touch with the world, a talker, is apt to develop a form of obsessive neurosis which may necessitate the forceful repetition of obscene words or actions. These are abruptly disallowed by the parents, and are substituted by grunts, sneezes, or other sounds more acceptable to the public. When the child is alone, however, as in bed at night, the active repetition of the forbidden word or phrase is heard in its full force. In the child of introverted temperament, on the other hand, the child who is less sociable, not so closely in touch with his fellows, more secretive, an energy conserver, of which the second case in this paper is a good example, the symptoms take a less violent or energetic form. The compulsions are limited to thoughts and stereotyped actions and ceremonials associated with every-day activities, such as washing, dressing, eating, etc.

The onset of the disorder is often insidious, the patient concealing from his relatives for many months the thoughts and actions by which he is obsessed. The parent usually considers that the symptoms date from an accident, a fall, a shock, etc., but an interview with the patient shows that they had antedated the supposed shock by many months and only became evident at that time on account of lowered resistance and less adequate nervous control. The majority of cases have shown symptoms for from two to five years before being sent for investigation and treatment. The parents at first think the child eccentric and make allowances for what they consider to be his peculiarities, but when the symptoms begin to interfere seriously with school attendance and show a likelihood of preventing the adolescent's entrance into the labour market, some definite step is taken to obtain advice.

It will be seen from the clinical cases that the symptoms are protean in number but that they fall into two main groups of subjective and objective, the subjective being the predominant ones. Of the mental symptoms, irritability of temper, emotional instability, obsessions, insomnia, fatigue, excitability, depression and inability to concentrate are the commonest, while physically, cardiac disturbances with palpitation and breathlessness, respiratory symptoms, more particularly feelings of suffocation and sighing, profuse sweating, tremors, paraesthesia, dizziness, disturbance of appetite and of bowel action and loss of body weight may be present. It will, of course, be apparent, as in all neuroses, that symptoms may be referred to any area or organ of the body.

Diagnosis.

The diagnosis of such cases is straightforward. A clear account of the history of the symptoms can usually be obtained from the parents, while the child has little difficulty in giving an account of his thoughts and feelings in that they are so real in their manifestations. The gradual onset of fear of unknown origin with the later development of obsessive acts and the accompanying symptoms of nervous exhaustion are typical. In those cases in which twitching movements, e.g., of the head and shoulders, skipping gait, tendency to kick the buttock with the heel of one foot every few steps, etc., are the predominant symptoms, a diagnosis of chorea has sometimes been made, but careful observation of the patient will reveal these as purposive and not involuntary movements, in that they are substituting the repressed thought or impulse. In a case in which the impulse to skip at every third step was firmly handled, this symptom vanished, but was replaced by a high-pitched squeak at similar intervals.

A possible, if infrequent, source of error in diagnosis is that of the mild manic-depressive state or cyclothymia. It is perhaps not commonly realized that these states may be observed in childhood, but such cases are of occasional occurrence in the experience of the psychiatrist. They are characterized by the usual symptoms of psychomotor over-activity,

insomnia, emotional instability and exhaustion. Dreads and obsessive acts, simulating obsessive compulsive states, may also occur. These are, however, fleeting, of no constant significance, and tend to clear up completely in the normal course of recovery within two or three months from onset of the disease.

Possibly the greatest difficulty in differential diagnosis, more particularly in cases of long-standing, is that of dementia praecox in its earliest stages. The real difference lies in the complete insight into his condition which the child with obsessive neurosis retains. Although he does not understand the cause of his symptoms, he realizes that they are odd, and can, to a certain extent, exert control over them. With the case of dementia praecox, on the other hand, although the child realizes in the early stages that some change has taken place in his thoughts and behaviour, and that his actions are peculiar, when urged to discuss his thoughts and feelings, his interpretation of these reveals mild, illusional, delusional and hallucinatory states, as, for example, the case of the boy who felt that he must look at everything he saw twice, when asked why this was necessary said, ' Because it changes into God, and it would be a sin to turn away from Him.' In conversation, too, the observer will be struck by the extreme normality of approach in the case of the neurotic as compared with the unreal and abnormal attitude and approach of the psychotic.

Another problem in differential diagnosis is presented by the illness known as maladie des tics (Gilles de la Tourette). What have usually been regarded as the pathognomonic features of this condition, notably stereotyped movements in face, neck, upper and lower extremities, beginning in the face and extending to the rest of the body, echolalia, coprolalia, compulsive ideas and gestures, are all present in many cases of the type under description. This might point to a psychogenic explanation to account for maladie des tics, but the problem is further complicated by the fact that the syndrome may appear during the course of certain organic affections such as epidemic encephalitis. It would seem, therefore, that the only point of differentiation can be whether or not the case responds to psychological investigation and treatment, an admittedly weak position. This instance at any rate serves to emphasize the difficulty, frequently experienced, of drawing a line of demarcation between conditions which have been distinguished as either ' functional ' or ' organic.'

Prognosis.

The outlook for recovery in cases of obsessive neurosis should be favourable if adequately handled during the developing years. It is sometimes asserted that obsessive-compulsive states tend to clear up in the ordinary course of events and that they therefore do not merit serious psychological understanding. In my view such an impression is unfortunate in that it frequently results in the case never being properly dealt

with and in the condition continuing with remissions and exacerbations, intermittently, and varying in intensity with the stresses and strains of human existence, throughout life. Moreover, however successful may be the result of treatment undertaken when the patient has reached young adult life, the process of such treatment is infinitely more difficult, complicated and prolonged than in childhood.

The most helpful adjunct to treatment is good, intellectual development in the patient, more particularly as regards powers of reasoning and application, in that the solution of the problem and disappearance of symptoms is dependent upon the patient's ability to discover and discuss those thoughts and experiences in his life which have been repressed through fear, shame and uncertainty, and have been acting as irritants of which the symptoms already described are the outward and more respectable manifestations.

Treatment.

To understand the mode of production of such disorders is to know how to handle them, and for that reason it is thought desirable to deal with the psychopathology of obsessive neurosis, before discussing management of the case and the method and technique of treatment.

(a) **Psychopathology.**—Although the disorder of obsessive neurosis presents so puzzling a group of symptoms on the surface, its origin is of comparatively simple foundation. The disorder may be summed up as the result of certain experiences acting upon the subconscious minds of certain predisposed personalities. A child who is by nature timid, lacking in confidence, sensitive to criticism, and who is over-conscientious in that he sets an unduly high standard of morals for himself and for others, comes in touch, for the first time, either at school or in the streets, with a more robust make of child to whom the facts of coitus, pregnancy and childbirth, among other information, are common knowledge. He sees, hears discussed, and becomes aware of the existence of such matters for the first time, but in such a way that his sensitive nature revolts and refuses to accept them. The instinctive curiosity born of his own half-awakened sexual impulses does not allow him to forget the incidents and facts. Thus, his mind is involved in a difficult conflict. On the one hand stand his moral standards, often taking dramatic form in an imaginative child who carries in his mind vivid mental pictures of religious punishments, disease and death. On the other hand, he is urged forward by his tardily developing instinctive trends. The latter are not sufficiently forcible to declare themselves so openly as in his more robust fellows; they therefore only express themselves behind a screen of behaviour to which no exception can be taken. Thus an endless succession of ceremonial acts based on scruples of apparently hygienic or religious significance become substitutes for the thoughts and acts which are abhorrent to the timid mind. The inevitable

result of this intra-psychic conflict is the characteristic anxiety state and its accompanying nervous manifestations.

Sexual experiences are common in childhood. A boy may indulge in sexual play with his sister or with a neighbour's child in a rigged-up tent. Although he realizes that such behaviour would not be admitted by adults, his sense of guilt is not stirred until he learns something of the significance of the function of the male and female sex organs. The fact that he obtains this knowledge from those who have but scant information themselves, but information of the grossest, crudest, most primitive kind, renders what might be a clean, wholesome and shameless explanation of these mysteries, a veritable nightmare of possibility.

(b) **Method.**—The first aim of treatment must be that of helping the child to unload his mind of those doubts and uncertainties which are molesting him. This process is easy in theory, yet, in practice, is beset with many difficulties. The average length of time required for recovery will be six months, the actual duration being dependent upon the length of the illness on the one hand and the readiness with which the child's confidence can be gained on the other. To most parents the idea of a six months' course of treatment is not a disadvantage in comparison with the years of anxiety that they have already endured. As in all children's work, there are always two persons to be considered in treatment, namely the child and his guardian. The parent must be willing to leave the case entirely in the hands of the doctor and only to act in exact accordance with his instructions. The parent must be given to understand that the treatment will be lengthy, but that an ultimate cure will result. He must give his consent for the child to be interviewed by the doctor alone and must promise not to question the child as to what occurs between patient and doctor. Should the child himself discuss the interviews the parent should be taught to refrain from criticism or comment, but to show by his attitude that he understands the situation and has faith in the ultimate outcome of the treatment. The parents must also be warned that there will be an exaggeration of the symptoms and increased irritability of temper and of general restlessness during the first few weeks of the treatment as this invariably happens and is apt to cause undue anxiety and distress to those in the home unless they have been previously warned. During the time that treatment is being undertaken, the child should not attend school, or be encouraged to indulge in any activities which require more effort than he can spare with ease. A quiet life in his own home with those who understand him is the ideal to be aimed at in the early stages of treatment.

With regard to the patient, his confidence must be gained by degrees. At first he will be suspicious; he has become so accustomed to such remarks as 'stuff and nonsense,' 'all your imagination,' 'you must learn to fight it,' in response to a recital of his symptoms, that he cannot conceive that they might be listened to with interest, nor that

anyone could really understand the effect that they have upon him. In my own experience of children under fourteen years of age, two visits a week each of thirty to forty-five minutes' duration is adequate time to devote to treatment. After physical factors have been excluded, the first interview alone with the child should give him an opportunity of describing his symptoms in detail. He should be encouraged to do this by such remarks as 'anything else you feel,' etc., until he realizes that you are truly interested in his case. The first interview may be terminated by telling him that you have known other boy and girl patients with just his trouble and that if he does what you ask of him there is no reason why he should not make a complete recovery just as they did. One never ceases to be amazed by the relief which follows the realization by the patient that other children have existed in whom the urge to count, to wash their hands, etc., has been present.

At the second interview, the patient should be given an opportunity of telling those things which he forgot to tell at the first interview. If you have gained his confidence he will have much to add. Much that he says may not appear to be relevant, as for instance the information given by a boy in the early stages of treatment, with a good deal of hesitation, that he had been told that if you picked a certain flower your mother would die. This remark seemed to have little significance until a later stage in treatment when it was discovered that he had derived information regarding the nature and risks of childbirth from the same source. At the end of the second interview it should be possible to begin to explain to the patient the facts with regard to the working of the subconscious mind. The idea of a deep mind and a superficial, or outside, mind with a constant conflict or battle between the two over something that is buried in the deep mind is readily understood by the average school child, but is particularly well understood by children suffering from obsessions in that their former vague symptoms now appear logical and the patient himself will find it possible to give evidence of the actual states of repression and conflict.

At this stage the patient will realize that you understand the nature of his case and will begin to fear that you will discover his innermost secret. It is this fear and the consequent increased conscious effort to retain the required information that causes an increase of the obsessions and of the general irritability of temper. Because there is a certain amount of strain resultant from treatment at this stage, it is wise to avoid hurrying the process. No element of cross-examination should enter in, but the patient should be allowed time to adapt slowly to the new attitude towards his symptoms. Be sure that the patient understands the way in which treatment is going to bring about a cure. Get him to suppose that he has been asked by his relatives how it works, and in this way you can be certain whether he really understands the process or not. At this stage he becomes really interested in his case and its solution, and this forms an inducement for him to tell you more of his

thoughts and experiences. Ask him about his dreams. At this stage of treatment they will be of great significance. He may tell you that he dreamt he came to see you and that you held a closed book in your hand which you opened to show him the clean leaves inside. Ask him what he thinks it means and he will tell you, if he has become used to thinking aloud in your presence, that you will explain things to him which have previously been a closed book to him. He may dream that he has been an inmate of a reformatory for a year but has obtained his release on good conduct before his time was up, explaining that the dream was an indication of his gradual return to normal standards of thought and behaviour. Guard against trying to extract a coherent life history from the patient. Allow him rather to tell his own story at his own pace.

If all goes well, after several weeks, the child will come to you slightly excited, and will blurt out some fact or tell you that he intends to get something off his chest before the end of the interview. He may weep, sob, laugh, or remain calm, as he informs you of the facts. It is important to remain detached in mind and unaffected by what he is trying to tell you. Allow him adequate time. Remember it is the telling that matters and not the material that is told. It must, of necessity, be something of a sexual or allied nature in that this is one of the few subjects on which he cannot approach his parents. He will describe events which were of no significance to him at the time they occurred except that he knew them to be wrong, but he will go on to explain that it was what he saw and heard at a later date that made him worry about the previous incidents.

From the moment of his confession, the obsessions will show definite improvement, but there are still weeks of difficulty ahead before they vanish completely. The child now wants to know the truth of the information that has been imparted to him by his undesirable associates. It is a great temptation at this stage to give the required sex information and to enquire in what way the truth differs from the facts as he first heard them, but to do so would be a gross error of judgment. He must tell you of the ideas he already holds with regard to these matters before you explain them to him; otherwise there may be fallacies in his knowledge which are not cleared up. Several more weeks may elapse, during which time it is important to make certain that he realizes that although he is now so very much better in that he can eat, sleep, play with other boys, only by dealing with every single doubt and uncertainty in his mind can he feel completely free. Finally the day will come when he has sufficient courage to repeat some of the things he has seen and heard, but has not understood. Once this ice is broken there is no looking back. He becomes the happy, care-free, contented child he was described to be by his parents before the onset of his illness. It may seem strange that it should take some months to obtain the information, the getting of which is so vital to the cure of the case, but these are invariably ambitious young people whose very self-respect acts as a deterrent in their attempts at full confession. How far the child's conscious mind is

aware of the cause of the trouble in the early stages of treatment varies with the individual case, but one boy described a ' blackness ' that gave him a headache when he first began to think about the cause of his obsessions, which gradually became less dense and no longer associated with pain in the head as he arrived nearer to the cause of his trouble.

In cases in which there appears to be an obstinate refusal to delve into the origin of the disorder, it may be legitimate to introduce information received from other children as examples for his encouragement or to explain the meaning of his symptoms, such as, for instance, hand-washing as a symbol of an attempt to remove some blemish or stain from the mind. This may give the patient renewed confidence in your understanding of the case and make him feel that he is not the only one who has experienced such thoughts and acts, and so enable him to progress at a faster rate. On the whole, however, so long as the parents are satisfied. it is wiser to allow the case to take its own course. In young people, a return to school after a period of six months of treatment should be possible in practically every case.

It is impossible to give, in a paper such as this, every likely symptom, cause and eventuality in treatment, but an understanding of the nature of the disorder and of the methods required to bring about an adjustment, brings the treatment of obsessive-compulsive states in children within the range of the practitioner who has sufficient time to devote to such cases.